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☐ 1. Document ID: US 5619919 A

L8: Entry 1 of 22 File: USPT Apr 15, 1997

DOCUMENT-IDENTIFIER: US 5619919 A
TITLE: Silk-screen print head for the printing of halftones on the surface of a substrate

Abstract Text (1):
A print head for silk-screen printing apparatus is provided. The silk-screen frame and squeegee of the print head are fixedly connected together to provide that the two move together in rotational manner. Thus, the squeegee can be made to always print across the square-shaped mesh of the woven screen rather than across diamond-shaped mesh whereby to eliminate or at least minimize or localize moire. The silk-screen frame and squeegee can be rotated together to a predetermined angle or degree, in advance of the printing of a particular color in the silk-screen printing of halftones.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KMC | Draw Desc | Image

☐ 2. Document ID: US 5463720 A

L8: Entry 2 of 22 File: USPT Oct 31, 1995

DOCUMENT-IDENTIFIER: US 5463720 A
TITLE: Blue noise based technique for use in a halftone tile oriented screener for masking screener induced image artifacts

Detailed Description Text (36):
The eight-bit data provided by RAM 735 are contone values which are applied to TPP 740. The TPP, in conjunction with microcomputer 713 as will be discussed in detail below, implements the above-described technique for providing tile-based image rotation, scaling and halftone screening. TPP 740 is appropriately configured by microcomputer 713 and processes a full tile of contone data at a time to yield, for example, resulting halftoned output bits therefor. Once the TPP is configured, such as by receiving tile starting coordinates, it processes the complete contone tile independently of microcomputer 713. As such, the microcomputer tiles the entire contone image, calculates the starting, i.e. ULC, coordinates for each tile and incremental sampling distances for the contone and halftone reference sampling, supplies this information to the TPP and then instructs the TPP to commence processing the first contone tile. After the TPP has completely processed this tile, the microcomputer updates the starting tile coordinates in the TPP for the next contone tile, commences processing of that tile by the TPP and so on for each successive contone image tile until the entire contone image has been processed. Tiling RAM 742, typically 128 Kbyte-by-8 bits, stores "N" complete lines, i.e. effectively a "strip", of the contone image for use by TPP 740. RAM 742 is formed of high speed RAM but owing to its relatively small size is advantageously far less expensive and complex to implement than a full size frame buffer of comparable speed. Based upon the actual number, "N", of contone image lines stored within RAM 742, TPP 740 can provide image scaling within the range of N to 1/N in each of the

fast and slow scan directions.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 3. Document ID: US 5297217 A

L8: Entry 3 of 22 File: USPT Mar 22, 1994

DOCUMENT-IDENTIFIER: US 5297217 A
TITLE: Tile-oriented technique for collectively performing image rotation scaling and digital halftone screening

Detailed Description Text (34):
The eight-bit data provided by RAM 735 are contone values which are applied to TPP 740. The TPP, in conjunction with microcomputer 713 as will be discussed in detail below, implements the inventive technique for providing tile-based image rotation, scaling and halftone screening. TPP 740 is appropriately configured by microcomputer 913 and processes a full tile of contone data at a time to yield, for example, resulting halftoned output bits therefor. Once the TPP is configured, such as by receiving tile starting coordinates, it processes the complete contone tile independently of microcomputer 713. As such, the microcomputer tiles the entire contone image, calculates the starting, i.e ULC, coordinates for each tile and incremental sampling distances for the contone and halftone reference sampling, supplies this information to the TPP and then instructs the TPP to commence processing the first contone tile. After the TPP has completely processed this tile, the microcomputer updates the starting tile coordinates in the TPP for the next contone tile, commences processing of that tile by the TPP and so on for each successive contone image tile until the entire contone image has been processed. Tiling RAM 742, typically 128 Kybyte-by-8 bits, stores "N" complete lines, i.e. effectively a "strip", of the contone image for use by TPP 740. RAM 742 is formed of high speed RAM but owing to its relatively small size is advantageously far less expensive and complex to implement than a full size frame buffer of comparable speed. Based upon the actual number, "N", of contone image lines stored within RAM 742, TPP 740 can provide image scaling within the range of N to 1/N in each of the fast and slow scan directions.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 4. Document ID: US 5204916 A

L8: Entry 4 of 22 File: USPT Apr 20, 1993

DOCUMENT-IDENTIFIER: US 5204916 A
TITLE: Tile-oriented technique for collectively performing image rotation, scaling and digital halftone screening

Detailed Description Text (35):
The eight-bit data provided by RAM 735 are contone values which are applied to TPP 740. The TPP, in conjunction with microcomputer 713 as will be discussed in detail below, implements the inventive technique for providing tile-based image rotation, scaling and halftone screening. TPP 740 is appropriately configured by microcomputer 713 and processes a full tile of contone data at a time to yield, for example, resulting halftoned output bits therefor. Once the TPP is configured, such as by receiving tile starting coordinates, it processes the complete contone tile independently of microcomputer 713. As such, the microcomputer tiles the entire

contone image, calculates the starting, i.e ULC, coordinates for each tile and incremental sampling distances for the contone and halftone reference sampling, supplies this information to the TPP and then instructs the TPP to commence processing the first contone tile. After the TPP has completely processed this tile, the microcomputer updates the starting tile coordinates in the TPP for the next contone tile, commences processing of that tile by the TPP and so on for each successive contone image tile until the entire contone image has been processed. Tiling RAM 742, typically 128 Kbyte-by-8 bits, stores "N" complete lines, i.e. effectively a "strip", of the contone image for use by TPP 740. RAM 742 is formed of high speed RAM but owing to its relatively small size is advantageously far less expensive and complex to implement than a full size frame buffer of comparable speed. Based upon the actual number, "N", of contone image lines stored within RAM 742, TPP 740 can provide image scaling within the range of N to 1/N in each of the fast and slow scan directions.

☐ 5. Document ID: US 5185662 A

L8: Entry 5 of 22 File: USPT Feb 9, 1993

DOCUMENT-IDENTIFIER: US 5185662 A
TITLE: Method and apparatus for producing copy with selective area treatment

Detailed Description Text (2):
With reference to FIG. 1 there is shown an electrophotographic copier apparatus 10 that includes a transparent glass platen 20 for supporting a document sheet for exposure. Flash lamps 22 are energized by a suitable power supply, not shown, in response to a signal from the copier logic and control unit (LCU) 31 to illuminate the document. The LCU provides various control signals for operating the copier to produce copy in accordance with signals provided thereto by the various stations as well as one or more encoders 17 that detect movements of belt 12. The image from the illuminated document is reflected from a first mirror 24 through a lens 26 to a second mirror 28 and projected onto a surface of a photoconductive belt 12. The surface includes a uniform electrostatic charge thereon that is provided by a corona charger 34. This charge is modulated by the exposure to provide an electrostatic latent image. A series of rollers 5, 6, 7 and 8, one of which, 5, may be driven by a motor to thereby entrain the belt 12 and drive same in the direction shown by the arrow so the belt is caused to move past the various workstations to be described. In addition to the charging station 34 and exposure station 30 described, the copier has situated about the belt one or more development stations 36 for developing the respective electrostatic latent images in a respective color using an electroscopic pigmented toner. The plural stations are provided where a document is to be reproduced so that a copy is in more than one color or the copy is reproduced in a selected different color from the original. After the development station, a transfer station is provided for transferring one or more color images onto a receiver sheet S. A source of copy sheets may be provided in a tray 27 and a top one of said sheets fed out in timed relationship with movement of a developed image frame of belt 12. Feed rolls may be employed to advance sheet S into the nip formed by a motor driven transfer roller 68 and the belt 12. The transfer roller may be charged to a suitable potential to attract toner on the image frame of belt 12 to the receiver sheet S to transfer the image thereto. A vacuum source may be provided to retain the sheet on the transfer roller 68 in the event that multiple images from more than one image frame are transferred to the sheet. After transfer of the developed image(s) to the surface of copy sheet S, the sheet follows the belt and exits at a fusing station wherein a pair of rollers 62, one of which is heated, fuse the image to the sheet as the sheet is transported between them and exits the copier. The belt, in turn, is cleaned by suitable conventional means such as a cleaning charger 70 and brush 66 for reuse for additional image formation for subsequent copies. In addition, an LED printhead 82 or other electro-optical

exposure surface is provided for selective editing, as will be described below. A gradient index lens array 86 may be provided for focusing the light from the LED's. Further details regarding a copier of this type are described in U.S. Pat. No. 4,791,450, the contents of which are incorporated by this reference. A copier providing selective area editing wherein halftone screening areas is provided is disclosed in U.S. Pat. No. 4,740,818, the pertinent contents of which are incorporated herein by this reference.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw. Desc | Image

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☐ 6. Document ID: US 5121224 A

L8: Entry 6 of 22 File: USPT Jun 9, 1992

DOCUMENT-IDENTIFIER: US 5121224 A
TITLE: Reproduction apparatus with selective screening and continuous-tone discrimination

Detailed Description Text (27):
The invention in its broader aspects also contemplates a method and apparatus for reproducing a composite original document formed of a continuous-tone information and line-type information by the steps of (a) forming a halftone pattern screen image on an entire image frame, (b) imaging the entire document on the image frame, (c) erasing selectively the areas of charge outside the continuous-tone information areas via signals indicating the locations to be erased, (d) imaging the entire document on a second image frame, (e) erasing selectively the areas of charge representing the continuous-tone information, and (f) transferring the two images in register onto the same surface of a copy sheet to form a reproduction. In order to form the halftone screen pattern on the one image frame, an integral screen photoconductor is used as described herein, however, a linear electroluminescent light panel is positioned proximate the web transverse to the direction of web travel. The panel would essentially take the place of LED array 58. The electroluminescent panel when energized would be used to illuminate the screen pattern over an entire image frame. A linear LED array may then be positioned facing the opposite surface of the web to selectively erase charge in accordance with signals designating the location of the continuous-tone areas.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw. Desc | Image

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☐ 7. Document ID: US 5075787 A

L8: Entry 7 of 22 File: USPT Dec 24, 1991

DOCUMENT-IDENTIFIER: US 5075787 A
TITLE: Reproduction apparatus and method with alphanumeric character-coded highlighting for selective editing

Detailed Description Text (41):
Character coding on the original document sheet may be used to designate areas to be selectively screened. The coordinates of the highlighted area may be processed and used to selectively illuminate an image of a halftone screen on the photoconductor in the area desired to be screened. A preferred way of accomplishing this is through use of a photoconductor having an integral screen as one of the layers thereof, as described in U.S. Pat. No. 4,294,536. In this mode (using the apparatus of FIG. 2) the first and second image frames on the photoconductor would both be exposed to all

the information on the document sheet. The area to be screened would be selectively erased from the first image frame; the second image frame would have the non-screened areas selectively erased and then the entire frame exposed to a screen pattern. The two image frames would then be developed and transferred in register to the same surface of a receiver sheet or support. For providing the screen pattern, the illumination from an electroluminescent panel 126 from the rear of the photoconductor (opposite that which is developed) could also be used. Further details may be found in commonly assigned U.S. Pat. No. 4,794,421 filed in the name of Michael D. Stoudt et al; the content of which is also incorporated herein by this reference. Reference is also made to U.S. Pat. No. 4,740,818, filed in the name of Tsilibes et al for selective screening techniques requiring only the use of one image frame to reproduce a document with selective screening.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 8. Document ID: US 4862217 A

L8: Entry 8 of 22 File: USPT Aug 29, 1989

DOCUMENT-IDENTIFIER: US 4862217 A
TITLE: Copying apparatus and method with editing and production control capability

Detailed Description Text (22):
The use of highlighting on the original document sheet may also be used to designate areas to be selectively screened. Rather than using a digitizing tablet as described in the commonly assigned U.S. application Ser. No. 940,694, now U.S. Pat. No. 4,740,818 and entitled, "Electrophotographic Reproduction Apparatus and Method With Selective Screening", in the names of George N. Tsilibes et al, the contents of which (and its parent applications identified above) are incorporated herein by this reference, to determine the coordinates of the areas desired for selective screening, these coordinates may be "read" by the highlight sensor and used to selectively illuminate an image of a halftone screen on the photoconductor in the area desired to be screened. A preferred way of accomplishing this is through use of a photoconductor having an integral screen as one of the layers thereof, see U.S. Pat. No. 4,294,536. In this mode (using the apparatus of FIG. 2) the first and second image frames on the photoconductor would both be exposed to all the information on the document sheet and the area to be screened selectively erased from the first image frame. The second image frame would have the non-screened areas selectively erased and the entire frame exposed to a screen pattern. The two image frames would then be developed and transferred in register to the same surface of a receiver sheet or support. Illumination from an electroluminescent panel 126 would be from the rear of the photoconductor (opposite that which is developed) and this mode called up by pressing button 129. In this regard, reference is made to commonly assigned U.S. application Ser. No. 809,550, filed on Dec. 16, 1985 and entitled, "Apparatus and Method for Electrophotographically Producing Copy From Originals Having Continuous-Tone and Other Content", in the name of Michael D. Stoudt et al; the contents of which are also incorporated herein by this reference.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 9. Document ID: US 4849322 A

L8: Entry 9 of 22 File: USPT Jul 18, 1989

DOCUMENT-IDENTIFIER: US 4849322 A
TITLE: Positive-working color proofing film and process

Detailed Description Text (3):
This coating is laminated at about 110.degree. C. to the smooth side of a 23 inch (58.4 cm) by 29 inch (73.7 cm) sheet of Kromekote.RTM. cast-coated one-side paper, manufactured by Champion Paper and Fiber Company, using a Cromalin.RTM. Laminator Model 2700 manufactured by E. I. du Pont de Nemours and Company, Wilmington, DE. This element is then given a blanket exposure with no artwork present in a Montakop vacuum contact frame manufactured by Siegfried Theimer Gmbh, Bad Homburg, West Germany fitted with a 5 KW photopolymer lamp. After the polyethylene terephthalate coversheet removal, a second clear photopolymer layer is laminated onto the first layer at 110.degree. C. A 150 lines/inch 50% halftone screen tint manufactured by Beta Screen Corp., Carlstadt, NJ is positioned on top. The sample plus tint is placed in a Montakop vacuum contact frame and exposed with a 5 KW photopolymer lamp and Kokomo.RTM. glass filter (No. 400), manufactured by the Kokomo Opalescent Glass Co., Kokomo, Ind. and given a sharp exposure where 2% highlight dots are just held. After exposure the tint and coversheet are removed. An Automatic Toning Machine Model 2900 manufactured by E. I. du Pont de Nemours and Company, Wilmington, DE is used to apply a magenta colorant material described in Example 11 of U.S. Pat. No. 4,215,193 to the photopolymer surface.

☐ 10. Document ID: US 4791450 A

L8: Entry 10 of 22 File: USPT Dec 13, 1988

DOCUMENT-IDENTIFIER: US 4791450 A
TITLE: Multicolor electrophotographic reproduction apparatus and method for producing color accented copies

Abstract Text (1):
A multicolor electrophotographic reproduction apparatus and method are provided for reproducing a copy in a selected colors. The apparatus includes a digitizer for inputting information denoting the location(s) of the pictorial information and the location(s) for which selected coloration is desired. The respective colors desired for reproduction of the information may be chosen from a menu of twenty-five or more colors stored in memory. In addition to an exposure source for reproducing an image of the original upon a photoconductor the apparatus also includes an illumination source for selective erase and a second illumination source which illuminates the photoconductor through a halftone screen to control the charge level on areas of a color separation image frame in accordance with the color selected to thereby effect the color which a reproduction will have.

CLAIMS:

1. A method for electrophotographically producing copy having selected information with color accenting, the method comprising the steps of;

(a) generating signals related to the desired color and position of an image area to be color accented relative to a reference;

(b) forming on a plurality of image frames of a photoconductive member a corresponding plurality of separate developable latent electrostatic images of the said information to be reproduced on the copy with selected accenting;

(c) exposing at least one of the image frames to non-image information bearing light modulated by a halftone screen pattern before, during or subsequent to step b) to reduce the charge level on an area corresponding to that for producing said selected information without similarly exposing the image(s) of the same information on

another image frame to the same extent;

(d) developing the latent electrostatic images with differently colored electroscopic toners

(e) transferring the developed images in register to a copy sheet.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 11. Document ID: US 4777510 A

L8: Entry 11 of 22 File: USPT Oct 11, 1988

DOCUMENT-IDENTIFIER: US 4777510 A
TITLE: Copying apparatus and method with editing and production control capability

Detailed Description Text (22):
The use of highlighting on the original document sheet may also be used to designate areas to be selectively screened. Rather than using a digitizing tablet as described in the commonly assigned U.S. application Ser. No. 940,694, filed on even date herewith and entitled, "Electrophotographic Reproduction Apparatus and Method With Selective Screening, in the names of George N. Tsilibes et al, the contents of which (and its parent applications identified above) are incorporated herein by this reference, to determine the coordinates of the areas desired for selective screening, these coordinates may be "read" by the highlight sensor and used to selectively illuminate an image of a halftone screen on the photoconductor in the area desired to be screened. A preferred way of accomplishing this is through use of a photoconductor having an integral screen as one of the layers thereof, see U.S. Pat. No. 4,294,536. In this mode (using the apparatus of FIG. 2) the first and second image frames on the photoconductor would both be exposed to all the information on the document sheet and the area to be screened selectively erased from the first image frame. The second image frame would have the non-screened areas selectively erased and the entire frame exposed to a screen pattern. The two image frames would then be developed and transferred in register to the same surface of a receiver sheet or support. Illumination from an electroluminescent panel 126 would be from the rear of the photoconductor (opposite that which is developed) and this mode called up by pressing button 129. In this regard, reference is made to commonly assigned U.S. application Ser. No. 809,550, filed on Dec. 16, 1985 and entitled, "Apparatus and Method for Electrophotographically Producing Copy From Originals Having Continuous-Tone and Other Content, in the name of Michael D. Stoudt et al; the contents of which are also incorporated herein by this reference.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 12. Document ID: US 4740818 A

L8: Entry 12 of 22 File: USPT Apr 26, 1988

DOCUMENT-IDENTIFIER: US 4740818 A
TITLE: Electrophotographic reproduction apparatus and method with selective screening

Detailed Description Text (42):

The invention in its broader aspects also contemplates a selective screening method and apparatus disclosed in application Ser. No. 809,550, entitled "Apparatus and Method for Electrophotographically Producing Copies From Originals Having Continuous Tone and Other Content," filed on Dec. 16, 1985 in the name of Michael D. Stoudt et al, the contents of which are incorporated herein. In that application, a method and apparatus are disclosed for reproducing a composite original document formed of a continuous tone information and line-type information by the steps of (a) forming a halftone pattern screen image on an entire image frame (b) imaging the entire document on the image frame (c) erasing selectively the areas of charge outside the continuous tone information areas via signals indicating the locations to be erased (d) imaging the entire document on a second image frame (e) erasing selectively the areas of charge representing the continuous tone information, and (f) transferring the two images in register onto the same surface of a copy sheet to form a reproduction. In order to form the halftone screen pattern on the one image frame, an integral screen photoconductor is used as described herein, however, a linear electroluminescent light panel is positioned proximate the web transverse to the direction of web travel. The panel would essentially take the place of the LED's 81, optical fibers 82 and GRIN 86. The electroluminescent panel when energized would be used to illuminate the screen pattern over an entire image frame. A linear LED array or GRIN array receiving light from selectively illuminated LED's may then be positioned facing the opposite surface of the web to selectively erase charge in accordance with signals provided via digitizing of the location of the continuous tone areas.

Detailed Description Text (54):
As previously described, image exposure is effected by flash lamps 203 and 204, which forms a latent electrostatic image of the document sheet on the web. Formation of a plurality of charge islands within the latent electrostatic image is effected by a second exposure through the rear of the web and through the integral halftone screen formed in the web. This rear exposure may be carried out prior to, simultaneous with, or after image exposure of the photoconductor, the only requirement being that this rear exposure be carried out after charging by charger 217 and prior to development. As the data in the bit map is determined using light from the exposure source 203, 204, the LED bank can only be located before the exposure station when a preflash (preliminary flash) from sources 203, 204 is used to illuminate the document. Since it is known to use such a preflash to expose a preceding frame to clean adjacent interframe areas on a photoconductor, this preflash may also be used to provide the image exposure information to be read by the image sensor 270. The advantage of using this preflash is that extra time is provided for the image signal processor to process the data to determine the areas of the next image frame on the photoconductor that are to be selectively screened for the first exposure of that document sheet. Succeeding exposures of the same document sheet for producing additional copies need not be preflashed for interframe erase, nor is there a need for the image sensor 270 to be operative. It would thus be advantageous to logically couple the image sensor to the control logic establishing a preflash so that the sensor is turned on or is operative for the reading of the preflash, but is turned off during exposure of subsequent image frames which are to be developed.

CLAIMS:

43. In a method for making electrophotograhic reproductions, the method including the steps of (a) exposing a plurality of image frames of a photoconductive member having a electrostatic charge thereon to image forming illumination to form a plurality of developable latent color separation electrostatic images of the information to be reproduced which includes information that is to be reproduced with a screen pattern and information that is not to be reproduced with a screen pattern, (b) separately exposing at least some of the same image frames to light modulated by a halftone screen pattern before, during or subsequent to said first exposing step to form a screened latent electrostatic images of the halftone screen pattern only in those areas of each image frame which are to reproduce the information that is to be reproduced with the screen pattern; and (c) developing the latent electrostatic images using toners of different colors and (d) transferring the developed images to a copy sheet.

☐ 13. Document ID: US 4734356 A

L8: Entry 13 of 22 File: USPT Mar 29, 1988

DOCUMENT-IDENTIFIER: US 4734356 A
TITLE: Positive-working color proofing film and process

Detailed Description Text (3):
This coating is laminated at about 110.degree. C. to the smooth side of a 23 inch (58.4 cm) by 29 inch (73.7 cm) sheet of Kromekote.phi. cast-coated one-side paper, manufactured by Champion Paper and Fiber Company, using a Cromalin.RTM. Laminator Model 2700 manufactured by E. I. du Pont de Nemours and Company, Wilmington, DE. This element is then given a blanket exposure with no artwork present in a Montakop vacuum contact frame manufactured by Siegfried Theimer Gmbh, Bad Homburg, West Germany fitted with a 5 KW photopolymer lamp. After the polyethylene terephthalate coversheet removal, a second clear photopolymer layer is laminated onto the first layer at 110.degree. C. A 150 lines/inch 50% halftone screen tint manufactured by Beta Screen Corp., Carlstadt, NJ is positioned on top. The sample plus tint is placed in a Montakop vacuum contact frame and exposed with a 5 KW photopolymer lamp and Kokomo.RTM. glass filter (No. 400), manufactured by the Kokomo Opalescent Glass Co., Kokomo, Ind. and given a sharp exposure where 2% highlight dots are just held. After exposure the tint and coversheet are removed. An Automatic Toning Machine Model 2900 manufactured by E. I. du Pont de Nemours and Company, Wilmington, DE is used to apply a magenta colorant material described in Example 11 of U.S. Pat. No. 4,215,193 to the photopolymer surface.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☐ 14. Document ID: US 4143967 A

L8: Entry 14 of 22 File: USPT Mar 13, 1979

DOCUMENT-IDENTIFIER: US 4143967 A
TITLE: Latent photo system

Detailed Description Text (14):
A further embodiment of the invention can be seen in FIG. 8 where the negative latent halftone is adjacent to or 30.degree. from the positive latent halftone, using only two angles of the dark screen 14, 75.degree. and 105.degree.. The remaining two angles 45.degree. and 90.degree. could be utilized to produce a second latent halftone in the same square inch area. In this same vein the four angles, 45.degree., 75.degree., 90.degree. and 105.degree. could be used to photograph four different positive or negative halftones through the dark screen 14. These latent halftones can be viewed by turning the dark viewing screen to the angle of the halftone, producing only one halftone in the visible form while isolating the remaining three from view because of the 15.degree. or 30.degree. angle difference between them; therefore four latent images can be stacked one on top of the other on the same frame of film.

☐ 15. Document ID: US 4043663 A

L8: Entry 15 of 22 File: USPT Aug 23, 1977

DOCUMENT-IDENTIFIER: US 4043663 A
TITLE: Device for applying a flexible halftone screen over a camera vacuum platen

Abstract Text (1):
A roller is coupled to a movable support frame which in a first position bears a flexible halftone screen which is fully wound up about said roller. As the support frame is translated in a first direction across the film mounted upon a vacuum platen, the flexible screen unwinds and is laid flat across the platen. When the movable support frame is translated in a second direction, the screen is thereafter wound up about said roller somewhat in the manner of a "reverse windowshade."

Detailed Description Text (2):
FIG. 1 schematically illustrates one principle of the invention. A vacuum platen 1 is provided having a sheet of film 2 positioned thereupon which is exposed to a focused image of an object on copyboard 3. Roller 4 has the flexible halftone screen wound up thereabout and a terminal portion of screen 6 is mechanically coupled to the frame of the camera at frame portions 7 and 7'. As the roller is translated across the platen in the direction indicated by arrow 8, the screen is laid flat over the platen. At the end of the translation of roller 4, the screen 6 covers film 2 as shown in FIG. 2. As the roller 4 is translated back across the platen in the direction of arrow 9, the screen is thereafter wound up about the roller. Further details of one constructed embodiment are illustrated in FIGS. 3 and 4. Roller 4' is rotatably and detachably coupled to a first movable frame portion 11 and a second movable frame portion 12 by means of detachable coupling device 13 and 14. Lead screws 16 and 16' are provided to translate the movable roller support across the platen. The lead screw or screws may be driven by a motor, not shown in the interest of clarity. A cross bar 18 may be provided to couple the first and second frame portions together. FIG. 2 illustrates terminal screen portion 6' being coupled to mechanical ground at 21. The screen is wound up about the roller in FIG. 2. As the movable roller support is translated across the platen by virtue of the aforementioned lead screws, the screen is applied and removed from the film surface as described hereinabove. A pulley 23, shown in FIG. 2, having grooves therein is provided wherein a flexible wire 24 for example is coupled to the pulley and is positioned within the grooves. The wire extends in a direction parallel to the surface of the platen and is coupled to mechanical ground at 26 via spring 27. This structure rotationally biases the roller in a second direction opposite to the direction of rotation which occurs when the screen is being unwound in a first direction indicated by arrow 29. This arrangement serves to maintain the screen in a tightly wound up condition about the pulley regardless of its position with respect to the surface of the platen. The use of this structure is greatly preferred so that the screen is laid flat over the platen. The spring means, of course, may take numerous forms, but it is preferred that it be of a type which asserts a constant force with respect to the pulley, regardless of the position of the movable roller with respect to the platen. The pulley may be rotatably supported within the first movable frame portion 11 by bearing 31.

☐ 16. Document ID: US 3647471 A

L8: Entry 16 of 22 File: USPT Mar 7, 1972

DOCUMENT-IDENTIFIER: US 3647471 A
TITLE: PHOTOGRAPHIC REPRODUCTION OF HALFTONE SCREENS

Detailed Description Text (5):
The photographic master may now be used to produce a halftone screen in accordance with the method of the invention. To produce a halftone screw from a pair of glass orthochromatic plates, one such plate 50 is placed in a vacuum frame, with its photosensitive emulsion 54 side up. The plate 50 is of the standard and well-known type used in professional photography. The photographic master 14 produced in the manner described in the preceding paragraph is placed upon the plate 50, emulsion side down. Remove the air from the vacuum frame. The vacuum frame may be of any suitable and well-known construction, such as is conventionally used in making photolitho plates and the like. Expose the master 14 and plate 50 to a light source. The type of light source or time of exposure is a matter of choice, it only being required that complete exposure occur, not insufficient or excess exposure. Insufficient exposure will cause the lines to be thin and light in color. Excess exposure will cause the lines to become blurred and not definite at the edges. Open the vacuum frame to the air and remove the photographic master and the exposed orthochromatic plate 50. Develop the plate by conventional methods and dry. A second glass orthochromatic plate 52 is then prepared in the manner just described. The pair of plates thus formed, and having identical line ruling, are then combined into an integral structure. To accomplish this, place the first plate 50 in a wooden rack with the emulsion 54 side up. Cover the plate 50 with a transparent adhesive such as Canada Fir Balsam (Balsam has substantially the same index of refraction as glass). Place the second plate 52 on top of the Balsam with emulsion 56 side down. Press out excess Balsam and let dry until the plates 50 and 52 are cemented together. Remove the plates 50 and 52 from the rack and place a metal binding around all four edges of the resulting halftone screen. The screen is now ready for use.

Detailed Description Text (6):
A second embodiment of the invention utilizes a photosensitive emulsion supported on a plastic sheet (viz, conventional orthochromatic film) in lieu of sensitized glass plates. To form a halftone screen from orthochromatic film, place an unexposed sheet of orthochromatic film 58 in a vacuum frame, emulsion 60 side up. Place the photographic master 62 emulsion 64 side up. Place the photographic master 62 emulsion 64 side down upon the film (emulsion to emulsion). Activate the vacuum frame. Contact print by exposing the orthochromatic film from a light source through the photographic master 62. Return air to the vacuum frame. Pick up the master 62 and turn it over. The film 58 and the master 62 will not now be emulsion-to-emulsion. Because the ruled lines of the master 62 are ruled at a 45.degree. angle with respect to the edges of the master 62 by turning the master 62 over the lines of the master 62 are now 90.degree. to the exposed lines upon the film 58. Again remove the air from the vacuum frame and reexpose the master 62 upon the film 58, keeping the exposure times exactly the same. Return air to the frame, remove and store the master 62, and develop the film 58. After the film 58 is dried at room temperature, place the film 58 upon a sheet of polished plate glass 6 covered with Canada fir Balsam, or other suitable optical cement, located within a wooden rack. Place the cement on the free side of film 58 and place another piece of polished plate glass 68 upon the film 58. Remove excess cement and permit to dry. Remove the film 58 and glass 66 and 68 from the rack and place a metal binding around the four edges of the resulting halftone screen. The photographic halftone screen is now ready for use.

DOCUMENT-IDENTIFIER: US 3607274 A
TITLE: METHOD FOR OBTAINING PRINTING MEDIA HAVING RELIEF EFFECT

Detailed Description Text (8):
The manner in which the two-part frame 10 is used in the practice of the present invention can best be understood from the simplified diagrammatic illustrations of FIGS. 11 and 12 which illustrate the frames in progressive positions of movement. Specifically, the starting condition of the frames 12, 14 is illustrated in FIG. 11. This condition consists of a negative mask NM (FIG. 2) being secured in place within the frame opening 14a. At this time, similarly secured in place, but in the opening 12a of the lower frame, is an arrangement of a positive mask PM (FIG. 4), a magenta Kodak contact screen S, and a sheet of film F. The contact screen is a halftone contact screen. At this time, the negative mask NM and the positive mask PM should be in perfect registration. In FIGS. 11, 12, crosshatching has been used to designate the opaque areas of the masks NM, PM.

Detailed Description Text (9):
The arrangement just described is then exposed to a pinpoint source of light, preferably located approximately 8 feet away, for a preferred exposure duration of approximately 30 seconds. During this exposure period, by proper manipulation of the treadably adjustable member 22, the upper frame 14 is moved slowly to the left of the lower frame 12, so that the relative movement of the masks NM and PM is translatory and parallel, being in a plane parallel to each other and to the screen S and the film F, with the result, as illustrated in FIG. 12, that light passes through the arrangement of masks and through the screen S to cause selective area exposure of the film F. As generally understood, the halftone contact screen S is effective to cause light dispersion over the exposed area which in turn produces small dotlike exposed areas on the film F. Moreover, since at the first instance of movement of the upper frame 14 relative to the lower frame 12, a film area is exposed which continues to be exposed during the entire 30-second duration, while, in contrast, at the end of the exposure duration the adjacent areas are exposed, of necessity, for correspondingly lesser periods of time, the dots in the initially exposed area are heaviest in character. This in turn produces the shadow effect consisting of heavy and fine dots as illustrated in the positive shadow of FIG. 6.

☐ 18. Document ID: US 3599544 A

L8: Entry 18 of 22 File: USPT Aug 17, 1971

DOCUMENT-IDENTIFIER: US 3599544 A
TITLE: PHOTOCOMPOSING APPARATUS

Detailed Description Text (34):
It should be noted that the image-producing means very generally designated by the reference numeral 94 is not limited to two rows each comprising a plurality of laterally adjacent matrices, such as those indicated at 110 or 110', but may also include means in certain forms of the invention for mounting a film transparency or the like which bears one or more pictorial representations. This might merely comprise an alternate form of the previously mentioned frame 104 which includes means such as an apertured slipover edge frame or the like for mounting a film transparency or the like substantially directly over and extending downwardly through the slotted portion 102 so as to allow the substantially direct contact printing of such a pictorial representation on the underlying film panel 28IR. A film transparency adapted for such use may be either a negative or a positive of any conventional type, and, if desired, a halftone screen may be superimposed between it and the underlying film panel 28IR so that a latent image produced therefrom on the underlying film panel 28IR will be suitable for the direct production of a halftone

printing plate portion corresponding thereto. Such a film transparency may bear a pictorial representation or may bear one or more ruling lines which may be arranged in parallel relationship and/or perpendicular relationship and may be single or plural in number so that the fully exposed film panel 28IR after development will bear desired ruling lines corresponding to any particular desired multiple-space-defining form or the like. This type of ruling line may also be borne by one or more matrix-mounting members 106 of the general type described hereinbefore or by a modified matrix-mounting member effectively bearing one or more such lines sideways along the lateral length direction of the underlying slot 102 and the orientation of the line image produced thereby on the underlying film panel 28IR can be readily adjusted by reason of the rotary turret action positioning adjustment of the multiple matrix holder indicated generally at 98 which will be described in greater detail hereinafter. Of course, in this type of arrangement a light shield such as that shown at 125 may be employed if only one-half of the matrix mounting member of transparency is desired to be exposed in a manner similar to that described hereinbefore. HOwever, in other forms of the invention, the light shield may be eliminated entirely and the transparency or matrix-mounting member may adequately define and limit the light passing downwardly therethrough to a desired dimension corresponding to a line space on the underlying film panel 28IR or to any desired multiple thereof.

☐ 19. Document ID: US 3564130 A

L8: Entry 19 of 22 File: USPT Feb 16, 1971

DOCUMENT-IDENTIFIER: US 3564130 A
TITLE: ELECTRONIC PHOTOCOPY SYSTEM

Detailed Description Text (8):
In operation, the continuous tone image on the original picture 12 is converted into a halftone image displayed on the display device 14 and photographed by the camera 15. The scanning beam 32 in the scanner 16 is initially positioned to the upper left-hand corner of the tube 16 when the photocopy system 10 is energized because the counters 36 and 38 are reset to establish such a deflection. The scanner 16 therefore produces the dot 100 as shown in FIG. 2 when the scanning beam 32 is unblanked. The generation of the dot synchronizing pulses and the dot blanking pulses causes the scanning beam 32 is unblanked. The generation of the dot synchronizing pulses and the dot blanking pulses causes the scanning beam 32 to be moved across the scanner 16 producing the displaced typewriter scan pattern shown in FIG. 2. There may, for example, be 250 horizontal dot positions across the face of the scanner 16 and 175 vertical scanlines. Each dot position is determined by the count in the counters 36 and 38. Each dot sync pulse generated in the generator 28 is counted by the counter 36 to produce a digital output count that is converted by the X DACON 40 into analogue voltages. The analogue voltages from the DACON 40 are converted into an analogue current that deflects the scanning beam 32 in steps across the scanner 16. The dot blanking pulses generated in the sync generator 28 are applied to blank the scanning beam 32 in the scanner 16 when the scanning beam 32 moves across the scanner. At the end of one scanline of dots, a horizontal or line sync pulse is produced by the master sync generator and applied to the counter 38. Such a count moves the scanning beam 32 down one scanline. Thus, an orthogonal scanning pattern is produced. A line blanking pulse is also produced at the end of a scanline to blank the scanning beam 32 on retrace to the second scanline position denoted by the dot 102 in FIG. 2. It is to be noted that the dot 102 in FIG. 2 is displaced so as to lie midway between the first two dots in the top scanline. This is accomplished by the triggering of the flip-flop 51 to its set state by the first horizontal sync pulse in a frame. The flip-flop 51, when set, introduces an incremental signal to the X DACON 40 to cause the output of this DACON to displace the dots. When the dots 102 in the second scanning row are displaced to be between

the dots in the first scanning row and the rows are spaced apart a distance equal to one-half the spacing between horizontal dots, a 45.degree. scan pattern is produced as shown in FIG. 5a. Such a 45.degree. pattern is utilized in mechanical printing by Ronchi halftone screens. Each of the dots 100, 102, etc., is imaged onto the original continuous tone picture 12 by the lens system 34. These dots of light produce beams that are transmitted through the picture 12 with different intensities depending upon whether a light or dark tone appears at the particular portion being scanned on the picture 12. It is assumed in this description that the picture 12 is a negative transparency of an original scene. In the negative transparency 12, a tone is light when a high level of light is transmitted through the transparency and conversely a tone is dark or somewhat opaque to light when a low level is transmitted. It is to be noted that a transparency 12 need not be utilized since the light from the dots 33 will also be reflected from an opaque print.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 20. Document ID: WO 8703708 A1

L8: Entry 20 of 22 File: EPAB Jun 18, 1987

DOCUMENT-IDENTIFIER: WO 8703708 A1
TITLE: MULTICOLOR ELECTROPHOTOGRAPHIC REPRODUCTION APPARATUS AND METHOD FOR PRODUCING COLOR ACCENTED COPIES

Abstract (1):
CHG DATE=19990617 STATUS=O>A multicolor electrophotographic reproduction apparatus and method for reproducing a copy in selected colors. The apparatus includes a digitizer for inputting information denoting the location(s) of the pictorial information and the location(s) for which selected coloration is desired. The respective colors desired for reproduction of the information may be chosen from a menu of twenty-five or more colors stored in memory. In addition to an exposure source for reproducing an image of the original upon a photoconductor the apparatus also includes an illumination source for selective erase and a second illumination source which illuminates the photoconductor through a halftone screen to control the charge level on areas of a color separation image frame in accordance with the color selected to thereby effect the color which a reproduction will have.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 21. Document ID: NB85036118

L8: Entry 21 of 22 File: TDBD Mar 1, 1985

DOCUMENT-IDENTIFIER: NB85036118
TITLE: Compatible Stereoscopic Television Transmission

Disclosure Text (1):
- This article presents a method of color transmission of full depth stereoscopic television that is compatible with monocular reception on a standard television set. Both channels are compressed onto a standard single channel bandwidth format with negligible loss of quality. Life is aligned with gravity, trees grow up and water lies flat, and, therefore, most images have a spatial frequency spectral density containing stronger horizontal and vertical components than diagonal. Perhaps in adaptation to this, the human eye also is anisotropic in sensitivity by typically 25%. Multiplying the biases of both the image and eye yields the perceived

importance, i.e., energy sent times attenuation at the receiver, which when plotted on a two-dimensional image spatial frequency graph gives a diamond-shaped bandwidth requirement. This signal spectra is diamond-shaped, the eye response is also diamond-shaped, and even the response of a CRT display with controlled blurring is at least circular. However, when plotted on a two-dimensional image spatial frequency graph, the channel bandwidth of standard television is rectangular, allocating bandwidth into corners that contain little image signal, are poorly reproduced on the display, and ignored by the eye as a receiver. In the present stereoscopic system, these corners are filled with the stereoscopic channel. The basic method is illustrated in Fig. 1. Each step depicts both a spatial image and its spatial spectral transform bandwidth directly beneath. The method begins with left and right images 'a' and 'b'. Image 'a' is multiplied by a diagonal grid 'c' which consists of two sine-wave gratings oriented at 45 . The product 'd' has raised the baseband to four positions defined by grid 'c', in analogy to the effect of multiplication in the temporal domain to amplitude modulate an audio signal, producing sidebands. Signals 'b' and 'd' are then added to form 'e'. In the spatial domain of 'e', the image of signal 'a' is not distinguishable at normal viewing distance, being perceived on close examination as a diagonal grid similar to a halftone screen. The bandlimiting effect of transmission yields the signal 'f', which the eye and display further bandlimit to recover the original 'g' = 'b'. The received signal is also multiplied by the same grid 'h' = 'c', in analogy to synchronous demodulation of a single sideband (SSB) signal to produce image 'i', which the eye and display further bandlimit to recover the other original 'j' = 'a'. Note that the spatial spectrum of 'a' was reproduced into four spectra in 'e'. Transmission passed only a quarter of each of these, leaving four quadrant fragments in 'f' which are correctly assembled in image 'i' to form the original spectrum. Next, the effects of the color signal are considered. Fig. 2A illustrates standard color transmission in which the spatial spectrum of a full frame of standard color video contains the center diamond baseband, four truncated diamonds of the magenta-green axis signal, or "Q" color channel, and phase overlapped with the "Q", four diamonds asymmetrically truncated on one side carrying the orange-blue axis signal, or "I" color channel. The rectangular asymmetry shown for the overall bandwidth is a characteristic of standard television, and was chosen to balance the effect of quantization in the vertical axis with more resolution in that axis. In a single field, the spectrum of Fig. 2A is folded twice like a letter, as shown. A comb filter separates the high frequencies in the vertical axis of folded Fig. 2A, while a conventional time filter isolates the high frequencies in the horizontal axis. The corners of the folded spectrum are thus clipped off, and when unfolded, the color and luminance channels have been clipped out, as shown by the dotted line in Fig. 2A, leaving the rest of the signal unattenuated. Fig. 2B is similar to Fig. 2A but with the stereoscopic channel added. The stereoscopic signal has been shown with less vertical component, and also little low frequency component, which is the case for a signal containing the difference between the left and right views, which is effectively a single axis differential operation. Note that the stereoscopic signal has been neatly fit around the standard signal components. Referring to Fig. 3 for a specific encoding example, a conventional color camera receives a signal for the right channel. This signal is operated on by a conventional chroma matrix, and the three resulting signals are processed by respective spatial filters. These filters are required in standard television; however, in the present system they are modified to give a diagonal bandpass, rather than circular or square bandpass, and the color signals are further restricted in the vertical axis. The filtered signals are acted on by a conventional chroma modulator. Meanwhile, the left perspective is received by a monochrome camera with a color response and spatial response matched to that of the "Y" channel of the right perspective. Subtraction yields the luminance difference between the two perspectives. To permit a 6 dB attenuation of the stereoscopic signal without excessive noise, one of several known noise reduction methods can be used. Modulation of the stereoscopic signal is performed by multiplication with the proper sinusoidal grid or, in the time domain, multiplication by a sine wave of the proper frequency and phase. The sampling effects remove the vertical sidebands, and a fast-cut, low-pass SSB filter removes the horizontal sidebands to yield a quartered spectrum as in Fig. 1F. A recommended frequency of modulation is derived from the chroma modulation standard by frequency multiplying exactly by 6/5 with a phase-locked circuit. By using this frequency, and inverting the phase 180 at the end of each completed field, the diagonal grid is attained. This frequency places the suppressed carrier of the single sideband

stereoscopic channel 205 KHz below the FM aural signal, which is adequate because there is very little low frequency information in the stereoscopic difference channel. This frequency also places the stereoscopic suppressed carrier barely outside the maximum extent of the chroma sideband. The broadcast standard requires a transmitter to have a bandwidth to at least 4.18 MHz, which is within 115 KHz of the recommended stereoscopic modulation frequency. Suppression of the signal below 115 KHz suppresses spatial wavelengths longer than 1/6 the screen width. In normal images, the difference channel has no important information in such long wavelengths, and attenuation is possible without loss of quality. This transmitter compatibility permits present stations to relay a stereoscopic network feed with no additional investment. Finally, in Fig. 3 the conventional color video and the stereoscopic channel are summed, combined with conventional sync signals, and transmitted. Referring now to Fig. 4 for a receiver example, the right perspective is decoded as in the prior art. The chroma demodulator must use a comb filter to clip out the chroma channels, and must remove the aural signal and provide access to a signal containing no traps below the 4.3 MHz aural band. The color carrier synchronization signal is frequency multiplied by 6/5 using phase-locked circuitry, and inverted 180 once per field in the same phase sequence as used in transmission. The derived frequency and trap-free signal are multiplied to produce synchronous demodulation of the stereoscopic channel. The complement of the transmission noise reduction is applied to yield a recovered monochrome difference signal, which is added to the "Y" channel to recover the original left perspective monochrome signal. A human observer could sense depth of an object from a monochrome stereoscopic image, determine the color of the object from a monocular color image, and then color the object in the perspective view correctly. These steps are performed electronically by the circuit of Fig. 5 to synthesize the left channel chroma signal. In this figure, the right monochrome signal is cross-correlated with the left monochrome signal at a range of time differentials corresponding to different stereoscopic depths. The time displacement with the highest correlation between the right and left luminance signals selects a corresponding time displacement in the chroma signal of the right channel to generate the left chroma signal. In Fig. 5, D1 and D2 are delays of respectively the center tap of the delay and of the low-pass filters. Because of the color resolution tolerance of the eye, in commercial television, the time skew of the luminance and chroma signals is allowed to vary an amount that in a stereoscopic television provides an acceptable depth range from 3.5 meters to infinity even with no depth time skew correction at all. Depth sensing by correlation, as used in Fig. 5, fully provides the required accuracy for use in synthesizing the left chroma signal. Finally, in Fig. 4 the left channel monochrome and synthesized chroma signals are combined for a full-color left perspective image, which, with the full-color right perspective image already generated, is presented to the viewer using a stereo display system, such as polarized projection.

☐ 22. Document ID: WO 8703708 A DE 3679554 G EP 250556 A EP 250556 B JP 62502920 W US 4791450 A

L8: Entry 22 of 22 File: DWPI Jun 18, 1987

DERWENT-ACC-NO: 1987-178014
DERWENT-WEEK: 198725

TITLE: Multicolour electrophotographic reproduction appts. - has operator controlled light pen and digitising tablet defining areas to be accentuated which are copied in selectable colour

Equivalent Abstract Text (3):
In addition to an exposure source for reproducing an image of the original upon a photoconductor the apparatus also includes an illumination source for selective erasure and a second source which illuminates the photoconductor through a halftone

screen to control the charge level on areas of a colour separation image frame in accordance with the colour selected to thus effect the colour which a reproduction will have.

Term	Documents
SECOND.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4026119
SECONDS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	350463
TWO.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	5300181
TWOES	0
TWOS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2434
TWOE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	13
SUBSEQUENT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	861733
SUBSEQUENTS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	21
SCREEN$3	0
SCREEN.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	631472
SCREENA.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	6
((SCREEN$3 NEAR2 HALFTON$3) SAME FRAME$3 SAME (SECOND OR TWO OR SUCCE$5 OR SUBSEQUENT OR SEQUEN$5)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	22

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☐ 1. Document ID: US 20020162176 A1

L7: Entry 1 of 45 File: PGPB Nov 7, 2002

DOCUMENT-IDENTIFIER: US 20020162176 A1
TITLE: Patterning system using a limited number of process colors

Summary of Invention Paragraph (12):
[0012] Generalizing this technique to accommodate unequal proportions or distributions of pixels that share a common color, a wide variety of colors can be generated using various arrangements and relative proportions of pixels that collectively are of two or more colors. For example, various shades of green can be reproduced with appropriate arrangements and relative proportions of blue pixels and yellow pixels. Similarly, given the availability of a "medium" blue as a process color, a variety of shades of blue, ranging from a powder blue (light blue) to a navy blue (dark blue), can be reproduced (when viewed at an appropriate distance) by using various arrangements and proportions of pixels that are colored white and blue (yielding a light blue) and black and blue (yielding a dark blue), with the relative number of white or black pixels comprising the mosaic determining the perceived relative lightness or darkness of the overall dithered pattern area. In connection with such dithering or halftone techniques, the term "heather" or "stipple" shall be used to describe the relative granularity of the image, where the eye is able to distinguish the individual pixels or groups of pixels that comprise the mosaic (i.e., dithered) area.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

☐ 2. Document ID: US 20020154339 A1

L7: Entry 2 of 45 File: PGPB Oct 24, 2002

DOCUMENT-IDENTIFIER: US 20020154339 A1
TITLE: De-screening halftones using sigma filters

Summary of Invention Paragraph (20):
[0018] The foregoing and other objects of the invention are achieved by de-screening a color image using a two-stage, color sigma filter which, similar to the anisotropic diffusion algorithm and total variation minimization techniques designed for gray scale images, is implemented as an O(N) algorithm which smooths out halftone dots while preserving edge information in the red/green/blue (RGB) color space. More specifically, the present invention combines a low-pass filter with the aforesaid color sigma filter, and generates de-screened images which appear piecewise smooth with edges preserved. The system and method of the present invention is applicable to any inverse halftoning process, as well as gray scale and color halftone images, because no assumption is made regarding the halftoning process used to produce the image. Further, the present invention satisfies the dual criteria of eliminating halftone screens while preserving edge information. When combined with halftone segmentation techniques, a complete document processing algorithm for gray-scale and color documents may advantageously be created.

☑ 3. Document ID: US 20020114011 A1

L7: Entry 3 of 45 File: PGPB Aug 22, 2002

DOCUMENT-IDENTIFIER: US 20020114011 A1
TITLE: Method and system for designing spatially-partitioned and correlated stochastic screens for color halftoning

Detail Description Paragraph (12):
[0042] The halftoning method is generalized to CMYK halftoning by using the same screen for K and C with "separation in thresholds" (as described later), the conjugate screen for M, and with Y on an independent rotated screen. Since the Y separation produces almost no change in luminance in the print and because the yellow colorants tend to have the least unwanted absorptions, the use of an independent halftone screen for yellow causes minimum degradation in image quality. The idea behind "separation in thresholds" is the one used in U.S. Pat. No. 5,631,748 by Harrington and in U.S. Ser. No. 09/602,746, "Color halftoning using a single successive filling color stochastic screen", by Sharma, Fan and Wang. The basic idea is to first halftone the K separation and then modify the C separation to occupy the next higher levels of the screen. Thus, for a constant image with K and C contone values i.sub.K and i.sub.C, respectively, the K separation occupies the first i.sub.K thresholds of the halftone screen and if there is no overlap required (i.sub.K+i.sub.C<255) the Cyan separation occupies thresholds from i.sub.K+1 through i.sub.K+i.sub.C. (See FIG. 2(b)) If overlap is necessary, the thresholds are re-used starting at zero. This is shown graphically in FIG. 2(c). The actual modification required in the Cyan separation to achieve this objective is simply the addition of the halftone error from the black separation (contone input-halftone output).

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

☐ 4. Document ID: US 20020106102 A1

L7: Entry 4 of 45 File: PGPB Aug 8, 2002

DOCUMENT-IDENTIFIER: US 20020106102 A1
TITLE: Methods and apparatus for hiding data in halftone images

Summary of Invention Paragraph (5):
[0003] Halftoning is a method widely used to transform multi-tone images (typically "grey-scale" images with 256 levels at each pixel, although in this document the term multi-tone is used to imply merely that there are at least 3 levels, or more preferably at least 10 levels) into a "halftone" image having only two tone colors (i.e. 2 levels) at each pixel. Such methods are used widely, for example in computer printers and for publishing newspapers, magazines and books. From a distance, halftoned images resemble images with multi-tones. The two most commonly used halftoning techniques are known as "ordered dithering" (see B. E. Bayers, "An optimum method for two level rendition of continuous tone pictures", Proc. of IEEE Int. Communication Conf., pp2611-2615, 1973) and "error diffusion" (R. W. Floyd, L. Steinberg, "An adaptive algorithm for spatial greyscale", Proc. SID, pp 75-77, 1976). Typically, the second of the two techniques produces half-tone images of higher quality.

☑ 5. Document ID: US 20020089708 A1

L7: Entry 5 of 45 File: PGPB Jul 11, 2002

DOCUMENT-IDENTIFIER: US 20020089708 A1
TITLE: Halftoning using dot and line screens to avoid two and three color moire

Summary of Invention Paragraph (13):
[0012] In order to address the above stated problems and provide the desired screening techniques, a method of halftoning a color image that avoids two and three color moir patterning has been developed. The method includes the step of: selecting a set of screens that have fundamental frequency vectors that combine to yield only moir frequency vectors of types selected from the group consisting of zero frequency moir frequency vectors, near zero frequency moir frequency vectors and high frequency moir frequency vectors. Zero, near zero and high frequency moir frequency vectors are associated with moir patterns that are not objectionable. The method also includes the steps of associating a first dot screen from the selected set of screens with a first colorant, associating a second dot screen from the selected set of screens with a second colorant, and, associating a first line screen from the selected set of screens with a third colorant. Once the colorants are associated with appropriate screens a color image is received for halftoning, and the screens are used to halftone the image.

Summary of Invention Paragraph (16):
[0015] In another embodiment the invention comprises a method of halftoning a color image that avoids two and three color moir patterning including the step of selecting a set of screens that have fundamental frequency vectors that combine to yield only high frequency moir frequency vectors. The method further includes the steps of associating a first dot screen from the selected set of screens with a first colorant, associating a first line screen from the selected set of screens with a second colorant, associating a second line screen from the selected set of screens with a third colorant, receiving the color image to be halftoned and, halftoning the color image with the associated screens.

Brief Description of Drawings Paragraph (21):
[0041] FIG. 19 is a flow chart outlining a method of halftoning and rendering a color image that avoids two and three color moir; and,

Detail Description Paragraph (109):
[0123] Referring to FIG. 19, in summary, a method 1910 of halftoning and rendering a color image, that avoids two and three color moir, can begin with a process effect analization step 1912. In the process effect analization step 1912 process effects, characteristic of a target rendering device, are considered. For example directions and frequency components of effects, such as, for example, development order effects, dual beam effects, photoreceptor velocity non-uniformity effects, mirror wobble effects, and/or raster start position jitter effects, are determined.

Detail Description Paragraph (115):
[0129] Referring to FIG. 20, an exemplary image processor 2010 operative to carry out the method 1910 of halftoning and rendering a color image that avoids two and three color moir, includes a screen set repository 2014, a halftoner 2018, an image input device 2022, a temporary image storage device 2026, a long term or bulk storage device 2030, general image processor components and functions 2034, a rendering device 2038 and a screen set searcher 2042.

CLAIMS:

1. A method of halftoning a color image that avoids two and three color moir, the method comprising the steps of: selecting a set of screens that have fundamental

frequency vectors that combine to yield only moir frequency vectors of types selected from the group consisting of zero frequency moir frequency vectors, near zero frequency moir frequency vectors and high frequency moir frequency vectors; associating a first dot screen from the selected set of screens with a first colorant; associating a second dot screen dot screen from the selected set of screens with a second colorant; associating a first line screen from the selected set of screens with a third colorant; receiving the color image to be halftoned; and, halftoning the color image with the associated screens.

4. The method of halftoning a color image of claim 2 wherein the step of: associating a second line screen with a fourth colorant comprises associating a second hybrid line screen with the fourth colorant.

9. The method of halftoning a color image of claim 2 wherein the step of: associating a second line screen with a fourth colorant comprises associating the second line screen with a yellow colorant.

22. A method of halftoning a color image that avoids two and three color moir patterning, the method comprising the steps of: selecting a set of screens that have fundamental frequency vectors that combine to yield only high frequency moir frequency vectors; associating a first dot screen from the selected set of screens with a first colorant; associating a first line screen from the selected set of screens with a second colorant; associating a second line screen from the selected set of screens with a third colorant; receiving the color image to be halftoned; and, halftoning the color image with the associated screens.

23. The method of halftoning separations of a color image of claim 22 wherein the step of associating a first line screen from the selected set of screens with a second colorant further comprises associating the first line screen with a cyan colorant.

24. The method of halftoning separations of a color image of claim 22 wherein the step of associating a second line screen from the selected set of screens with a third colorant further comprises associating the second line screen with a magenta colorant.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWMC | Draw. Desc | Image

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☐ 6. Document ID: US 6373594 B1

L7: Entry 6 of 45 File: USPT Apr 16, 2002

DOCUMENT-IDENTIFIER: US 6373594 B1
TITLE: Color printer halftoning method and apparatus

Brief Summary Text (9):
A more sophisticated halftoning approach for high quality printing of more than two colors has been disclosed in U.S. patent application No. 09/198,024, filed Nov. 23, 1998, to Yao et al., entitled "Color Printer Halftoning Method," the disclosure of which is incorporated herein by reference. While this is effective for very high quality four color printing, it requires significant processing resources to be devoted to the calculations required for halftoning each image.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWMC | Draw. Desc | Image

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☐ 7. Document ID: US 6363172 B1

L7: Entry 7 of 45 File: USPT Mar 26, 2002

DOCUMENT-IDENTIFIER: US 6363172 B1
TITLE: Combined color halftoning

Brief Summary Text (14):
In general, when halftoned by each of these three techniques, the pattern of dots for each individual colorant is visually pleasing. However, the pattern of dots formed by combining the dots of each of the color planes is not necessarily visually pleasing because no effort is made to insure that the dots of each of the different color planes are distributed relative to the dots of the other color planes. Examples of producing a color composed of two colorants with each of these three methods follow.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 8. Document ID: US 6307962 B1

L7: Entry 8 of 45 File: USPT Oct 23, 2001

DOCUMENT-IDENTIFIER: US 6307962 B1
TITLE: Document data compression system which automatically segments documents and generates compressed smart documents therefrom

Detailed Description Text (43):
In the preferred embodiment, printer 25 is a continuous tone printer. This allows printer 25 to print the image data representing OUTPUT DOCUMENT since this data is in the form of a two-dimensional array of pixels having gray scale values. System 10 however may be modified to operate with other types of non-continuous tone printers, such as binary or halftone printers. For example, if printer 25 is a binary or halftone printer, gray scale value information need no longer be maintained since only two colors can be printed (black and white). This simplifies system 10 operation since majority and minority gray scale levels (BGLS) are no longer needed. Also, encoding of gray scale macroblocks may be performed by other techniques than JPEG to even further increase data compression. Gray scale macroblocks in binary printers can be encoded by ToneFac, while in a halftone printer they can be halftoned by standard techniques, such as error diffusion.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 9. Document ID: US 6198843 B1

L7: Entry 9 of 45 File: USPT Mar 6, 2001

DOCUMENT-IDENTIFIER: US 6198843 B1
TITLE: Method and apparatus for color gamut mapping

Brief Summary Text (4):
Various types of apparatuses have been developed as media for color reproduction including color displays, dye-sublimation printers, ink-jet printers, photographs, and commercial printers. In general, color gamuts which can be reproduced by such

apparatuses significantly vary depending on the methods of color reproduction (color mixture), the methods for tone reproduction (halftone dot method, dithering, error diffusion method, etc), and differences in the spectral characteristics of the primary colors used. For example, it is known that the color gamut of a display is considerably wider than that of a dye-sublimation type printer. When color matching is performed between two apparatus having color gamuts of different sizes as described above, it is inevitable that some colors are unreproducible for one of the devices. Therefore, a problem arises in that it is necessary to find how to allow reproduce such colors out of such a color gamut at a device of interest.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 10. Document ID: US 6157462 A

L7: Entry 10 of 45 File: USPT Dec 5, 2000

DOCUMENT-IDENTIFIER: US 6157462 A
TITLE: Method and apparatus for error diffusion and undercolor removal/grey component replacement of digital color images

Brief Summary Text (19):
In accordance with another aspect of the preset invention, a method of halftoning a digital color image includes receiving continuous tone input pixel data for at least first, second, and third color separations and a fourth black separation of the digital color image, wherein the continuous tone pixel data (or a function of the continuous tone pixel data) of each pixel of the fourth black separation has been previously subtracted on a pixel-by-pixel basis from the continuous tone pixel data of each pixel of the first, second, and third color separations. For all pixels of the first, second, and third color separations, respectively the continuous tone pixel data from the corresponding pixel location of the fourth black separation is added thereto. An error diffusion halftoning operation is performed on the continuous tone pixel data of the black separation to derive binary pixel data for each pixel of the black separation. For the continuous tone pixel data at each pixel location of the first, second, and third color separations, binary black pixel data from a corresponding location of the fourth black separation is subtracted therefrom. An error diffusion operation is then performed on the continuous tone pixel data of the first, second, and third color separations to derive binary pixel data for each pixel of each of the first, second, and third separations.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 11. Document ID: US 6091849 A

L7: Entry 11 of 45 File: USPT Jul 18, 2000

DOCUMENT-IDENTIFIER: US 6091849 A
TITLE: Method for halftoning a multi-channel digital color image

Abstract Text (1):
A method for halftoning a multi-channel digital color image having an x,y array of color pixel values, includes the steps of: providing a matrix of dither values for each color channel of the digital color image wherein two or more of the matrices of dither values are designed jointly to minimize a visual cost function; for each color channel modularly addressing the matrix of dither values with the location of a pixel in the digital color image to obtain an addressed dither value; comparing

the addressed dither value for each color channel with the pixel value for the corresponding color channel to determine an output halftone image value for each color channel; and repeating steps b and c for each pixel in the digital image.

Brief Summary Text (4):
Halftoning is a technique that is commonly used in digital imaging to create the appearance of intermediate tones when only two colorant levels (i.e., ink or no ink) are available. Halftoning methods rely on the fact that an observer's eye will spatially average over some local area of the image so that intermediate tone levels can be created by turning some of the pixels "on" and some of the pixels "off" in some small region. The fraction of the pixels which are turned on will determine the apparent gray level. Examples of common halftoning techniques include ordered dither and error-diffusion.

Brief Summary Text (14):
The problems noted above are solved according to the present invention by providing a method for halftoning a multi-channel digital color image having an x,y array of color pixel values, includes the steps of: providing a matrix of dither values for each color channel of the digital color image wherein two or more of the matrices of dither values are designed jointly to minimize a visual cost function; for each color channel modularly addressing the matrix of dither values with the location of a pixel in the digital color image to obtain an addressed dither value; comparing the addressed dither value for each color channel with the pixel value for the corresponding color channel to determine an output halftone image value for each color channel; and repeating steps b and c for each pixel in the digital image.

☐ 12. Document ID: US 6062137 A

L7: Entry 12 of 45 File: USPT May 16, 2000

DOCUMENT-IDENTIFIER: US 6062137 A
TITLE: Application of spectral modeling theory in device-independent color space halftoning

Parent Case Text (2):
This application is related to U.S. Pat. No. 5,070,413, entitled "Color Digital Halftoning with Vector Error Diffusion"; U.S. Pat. No. 5,333,243, entitled "Method for Forming Color Images Using a Hue-Plus-Gray Color Model;" U.S. Pat. No. 5,377,024, entitled "Apparatus for Forming Color Images Using a Hue-Plus-Gray Color Model;" U.S. Pat. No. 5,333,243, entitled "Error Diffusion Applied to HNK Color Model;" U.S. Pat. No. 5,473,446, entitled "Color Digital Halftoning Using Black and Secondary Color Replacement and Color Vector Dithering;" U.S. Pat. No. 5,621,545, entitled "Image Production Using Color Error Diffusion". U.S. Pat. No. 5,657,137, entitled "Color Digital Halftoning Using Black and Secondary Color Replacement;" U.S. Pat. No. 5,710,827, entitled "Halftone Dither Cell with Integrated Preferred Color Matching;" U.S. patent application Ser. No. 08/238,137, filed May 3, 1994, entitled "Coordinating Color Produced by Two Devices Using a Hue-Controlled Machine Color Space or Surface Scanning;" U.S. patent application Ser. No. 08/789,859, filed Jan. 28, 1997, entitled "Image Rendition by Plural-Row Error Diffusion, for Faster Operation & Smaller Integrated Circuits;" U.S. patent application Ser. No. 08/960,766, filed Oct. 30, 1997, entitled "Constructing Device-State Tables for Inkjet Printing;" U.S. patent application Ser. No. 08/960,779, filed Oct. 30, 1997, entitled "Device State Error Diffusion Technique for Halftoning;" U.S. patent application Ser. No. 08/961,730, filed Oct. 31, 1997, entitled "Method and Apparatus for Ink Jet Printer Color Balance Calibration;"and U.S. patent application Ser. No. 09/042,880, filed Mar. 16, 1998, entitled "Banding Reduction in Incremental Printing, Through Use of Asymmetrical Randomized Superpixels." The foregoing commonly assigned patents and patent applications are herein incorporated by

reference.

☐ 13. Document ID: US 6014233 A

L7: Entry 13 of 45 File: USPT Jan 11, 2000

DOCUMENT-IDENTIFIER: US 6014233 A
TITLE: Error diffusion for color images with semi-vector quantization

Brief Summary Text (15):
In accordance with yet another aspect of the invention, there is provided a method of halftoning documents preparatory to reproducing at an output device the documents defined by plural separations, each separation including a set of color separation image signals describing optical density therein with c density levels, for a destination color output device rendering density with d density levels. At least two color separations including a first color and a second color separation image signals corresponding to a selected discrete area of the document are received and have been adjusted by error values distributed from previously processed discrete areas of the document. At least one color separation including a third color separation image signals corresponding to the selected discrete area of the document is received and have been adjusted by error values distributed from previously processed discrete areas of the document, the third color having less visual impact than the first and second colors. The first color and second color separation image signals for the discrete location of the document are added to create a sum value which is used to generate a first color output signal and a second color output signal whereby the first color and the second color are reproduced at the discrete area. A third color output signal whereby the third color is reproduced at the discrete area is produced.

☐ 14. Document ID: US 6002893 A

L7: Entry 14 of 45 File: USPT Dec 14, 1999

DOCUMENT-IDENTIFIER: US 6002893 A
TITLE: High and low pigment loadings for custom colors

Detailed Description Text (23):
In a particular embodiment of the present invention, a plurality of differently colored developing material supply dispensers 15A, 15B, 15C, . . . 15Z, each coupled to the operative supply reservoir via an associated valve member 16A, 16B 16C, . . . 16Z, or other appropriate liquid flow control device. Preferably, each supply dispenser contains a developing material concentrate of a known basic or primary color such as Cyan, Magenta, and Yellow. In one specific embodiment, the replenishment system includes as few as sixteen supply dispensers, wherein each supply container provides a different basic color liquid developing material corresponding to six or seven basic or constituent colors of the Pantone.RTM. Color Matching System as well as black and white. This embodiment contemplates that color formulations conveniently provided by the Pantone.RTM. System can be utilized to produce about a thousand desirable colors and shades in a customer selectable color printing environment. Using this system, as few as two different color liquid developing materials, from supply containers 15A and 15B for example, can be

combined in reservoir 10 to expand the color gamut of customer selectable colors far beyond the colors available via halftone imaging techniques.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 15. Document ID: US 5997132 A

L7: Entry 15 of 45 File: USPT Dec 7, 1999

DOCUMENT-IDENTIFIER: US 5997132 A
TITLE: Method and apparatus for improving image quality

Detailed Description Text (22):
FIGS. 12(a) and 12(b) illustrate the use of Achromatic Component Addition to effectively increase the resolution of dithered gradients since fewer addressable pixels are required to produce the same color graylevels. As described above, in a binary printing system using dithering or halftoning methods in order to increase the number of graylevels, the picture is divided into very small square matrices (also referred to as "super pixels"). Here, as illustrated in FIG. 12(a), the super pixel 150 comprises a 2.times.2 matrix of pixels 151, 152, 153, and 154. To produce the perception of color level, the color is applied in two spatial dimensions. Two cyan drops 46 deposited in pixels 152 and 153 are used with two white pixels 151 and 154 from the paper to synthesize a perceived 50% cyan block. As a result, three perceived color levels for the printed image can be created: saturated or unaltered cyan, white, and the perceived 50% cyan.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 16. Document ID: US 5973803 A

L7: Entry 16 of 45 File: USPT Oct 26, 1999

DOCUMENT-IDENTIFIER: US 5973803 A
TITLE: Combined color halftoning

Brief Summary Text (13):
In general, when halftoned by each of these three techniques, the pattern of dots for each individual colorant is visually pleasing. However, the pattern of dots formed by combining the dots of each of the color planes is not necessarily visually pleasing because no effort is made to insure that the dots of each of the different color planes are distributed relative to the dots of the other color planes. Examples of producing a color composed of two colorants with each of these three methods follow.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 17. Document ID: US 5953988 A

L7: Entry 17 of 45 File: USPT Sep 21, 1999

DOCUMENT-IDENTIFIER: US 5953988 A

TITLE: Screen printing process using rotated screens

Brief Summary Text (7):
By application of a halftone image to a screen, the halftone dots, making up the halftone image, will be re-sized by the screen structure, depending on the screen pitch versus the size of halftone dot used, and only an integer number of screen cells will be covered. This will reduce (quantization effect) the number of shades that can be reproduced. The halftone pattern will further interfere with the screen pattern due to the periodic structure of both the screen and the halftoning method, in turn the halftoned colour overprints will interfere because the same screen structure is used in printing, both resulting in moire patterns in the print. Colour stability will suffer from minute register variations between the subsequent colour prints due to varying overlap of the coloured dots. This situation puts practical limits for the halftone-screen printing combinations to guarantee fluent tone transitions and to prevent objectionable moire patterns or colour inaccuracies in the print. In order to avoid the above mentioned problems, for coarse screens, the use of halftoned overprints will be avoided.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 18. Document ID: US 5946452 A

L7: Entry 18 of 45 File: USPT Aug 31, 1999

DOCUMENT-IDENTIFIER: US 5946452 A
TITLE: Partially correlated minimum visibility halftone patterns for digital printers

Brief Summary Text (4):
Halftoning is a technique that is commonly used in digital imaging to create the appearance of intermediate tones when only two colorant levels (i.e., ink or no ink) are available. Halftoning methods rely on the fact that an observer's eye will spatially average over some local area of the image so that intermediate tone levels can be created by turning some of the pixels "on" and some of the pixels "off" in some small region. The fraction of the pixels which are turned on will determine the apparent tone level. Examples of common halftoning techniques include ordered dither and error-diffusion.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 19. Document ID: US 5933578 A

L7: Entry 19 of 45 File: USPT Aug 3, 1999

DOCUMENT-IDENTIFIER: US 5933578 A
TITLE: Method and device for determining the color appearance of color overprints

Detailed Description Text (15):
In the first embodiment of the method of the present invention, one determines parameters of the colorant by printing two sets of patches at different coverage percentages, one on a substrate of a first substrate color as determined by the substrate's reflection spectrum (for reflection printing) or transmission spectrum (for printing transparencies), and the second set of patches on a substrate of the same type but of a second substrate color different from the first substrate color.

In one embodiment, the substrate of the first substrate color is a lightly colored (e.g., white) substrate and, and the substrate of the second color is a medium colored substrate, the lightly colored and medium colored substrates being of the same substrate type. In the preferred embodiment, the medium colored substrate is a greyish substrate. Each set of patches goes from 0% to 100% colorant (e.g., ink) coverage (e.g., dot percentages for ink) in steps of 10% increments. Other embodiments may include fewer or more patches, with equal or unequal increments of ink coverage. Also, in the preferred embodiment, the printing of the patches is using halftone printing as would occur with offset printing, so that a patch of p % ink coverage means a halftone screen of a dot percentage of p %. The method is not limited to halftone printing. One can apply the method to modulated printing, such as color laser printing and dye sublimation printing. In such cases, for example, instead of a p % dot percentage screen, one would print an area of p % modulated colorant intensity. The method also applies to photographic printing and transparency making, in which case colorant coverage would represent the amount of photographic colorant. How to extend the methods of the present invention to non-screened printing would be clear to those of ordinary skill in the art.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 20. Document ID: US 5899605 A

L7: Entry 20 of 45 File: USPT May 4, 1999

DOCUMENT-IDENTIFIER: US 5899605 A
TITLE: Color mixing and color system for use in a printing machine

Detailed Description Text (20):
In one specific embodiment, the replenishment system includes sixteen supply dispensers, wherein each supply dispenser provides a different basic color developing material corresponding to the sixteen basic or constituent colors of the Pantone.RTM. Color Matching System such that color formulations conveniently provided thereby can be utilized to produce over a thousand desirable colors and shades in a customer selectable color printing environment. Using this system, as few as two different color developing materials, from supply containers 15A and 15B for example, can be combined in reservoir 10 to expand the color gamut of customer selectable colors far beyond the colors available via halftone imaging techniques or even the colors available from mixing just Yellow, Magenta, Cyan and Black colored developing materials.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 21. Document ID: US 5897239 A

L7: Entry 21 of 45 File: USPT Apr 27, 1999

DOCUMENT-IDENTIFIER: US 5897239 A
TITLE: Photometric color correction and control system for custom colors

Detailed Description Text (20):
The present invention, however, contemplates a liquid developing material replenishing system capable of systematically replenishing individual color components making up a customer selectable color liquid developing material composition. As such, the replenishment system of the present invention includes a plurality of differently colored developing material supply dispensers 15A, 15B,

15C, . . . 15Z, each coupled to the operative supply reservoir via an associated valve member 16A, 16B, 16C, . . . 16Z, or other appropriate liquid flow control device. Preferably, each supply dispenser contains a developing material concentrate of a known basic or primary color such as Cyan, Magenta, and Yellow. In one specific embodiment, the replenishment system includes sixteen supply dispensers, wherein each supply container provides a different basic color liquid developing material corresponding to the sixteen basic or constituent colors of the Pantone.RTM. Color Matching System. This embodiment contemplates that color formulations conveniently provided by the Pantone.RTM. System can be utilized to produce about a thousand desirable colors and shades in a customer selectable color printing environment. Using this system, as few as two different color liquid developing materials, from supply containers 15A and 15B for example, can be combined in reservoir 10 to expand the color gamut of customer selectable colors far beyond the colors available via halftone imaging techniques.

☐ 22. Document ID: US 5822451 A

L7: Entry 22 of 45 File: USPT Oct 13, 1998

DOCUMENT-IDENTIFIER: US 5822451 A
TITLE: Method for halftoning a multi-channel digital color image

Abstract Text (1):
A method for halftoning a multi-channel digital color image having an x,y array of color pixel values, includes the steps of: providing a matrix of dither values for each color channel of the digital color image wherein two or more of the matrices of dither values are designed jointly to minimize a visual cost function; for each color channel modularly addressing the matrix of dither values with the location of a pixel in the digital color image to obtain an addressed dither value; comparing the addressed dither value for each color channel with the pixel value for the corresponding color channel to determine an output halftone image value for each color channel; and repeating steps b and c for each pixel in the digital image.

Brief Summary Text (4):
Halftoning is a technique that is commonly used in digital imaging to create the appearance of intermediate tones when only two colorant levels (i.e., ink or no ink) are available. Halftoning methods rely on the fact that an observer's eye will spatially average over some local area of the image so that intermediate tone levels can be created by turning some of the pixels "on" and some of the pixels "off" in some small region. The fraction of the pixels which are turned on will determine the apparent gray level. Examples of common halftoning techniques include ordered dither and error-diffusion.

Brief Summary Text (13):
The problems noted above are solved according to the present invention by providing a method for halftoning a multi-channel digital color image having an x,y array of color pixel values, includes the steps of: providing a matrix of dither values for each color channel of the digital color image wherein two or more of the matrices of dither values are designed jointly to minimize a visual cost function; for each color channel modularly addressing the matrix of dither values with the location of a pixel in the digital color image to obtain an addressed dither value; comparing the addressed dither value for each color channel with the pixel value for the corresponding color channel to determine an output halftone image value for each color channel; and repeating steps b and c for each pixel in the digital image.

☐ 23. Document ID: US 5812744 A

L7: Entry 23 of 45 File: USPT Sep 22, 1998

DOCUMENT-IDENTIFIER: US 5812744 A
TITLE: Joint design of dither matrices for a set of colorants

Detailed Description Text (35):
The first halftone CMYK pattern we design will also influence all underlying patterns, i.e. patterns of a primary color (either cyan, or magenta, or yellow, or black), and secondary color (any combination of two colors from cyan, magenta, yellow, and black). The decomposition into underlying colors is illustrated in FIG. 7. FIG. 5 shows the method for generating the halftone patterns for color concentration levels 0 to n in accordance with the present invention. In the example shown in FIG. 5, N is equal to 255.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw. Desc | Image

☐ 24. Document ID: US 5781828 A

L7: Entry 24 of 45 File: USPT Jul 14, 1998

DOCUMENT-IDENTIFIER: US 5781828 A
TITLE: Liquid color mixing and replenishment system for an electrostatographic printing machine

Detailed Description Text (20):
In one specific embodiment, the replenishment system includes sixteen supply dispensers, wherein each supply dispenser provides a different basic color developing material corresponding to the sixteen basic or constituent colors of the Pantone.RTM. Color Matching System such that color formulations conveniently provided thereby can be utilized to produce over a thousand desirable colors and shades in a customer selectable color printing environment. Using this system, as few as two different color developing materials, for example, from supply containers 15A and 15B, are combined in reservoir 10 to expand the color gamut of customer selectable colors far beyond the colors available via halftone imaging techniques or even the colors available from mixing just Yellow, Magenta, Cyan and Black colored developing materials.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw. Desc | Image

☐ 25. Document ID: US 5740334 A

L7: Entry 25 of 45 File: USPT Apr 14, 1998

DOCUMENT-IDENTIFIER: US 5740334 A
TITLE: Quantization method for color document reproduction in a color printing system

Abstract Text (1):
The present invention is a method and apparatus for reducing two-color moire often found during the rendering of full color images using halftoning techniques. The

invention relies upon the application of a non-periodic halftone operation to the least perceptible color separation (e.g., yellow) so as to prevent the formation of periodic structures due to the interaction of the yellow colorant with one of the other colorants (e.g., cyan or magenta).

Brief Summary Text (3):
The present invention is a method and apparatus for halftoning the color separations of a digital color document so as to significantly reduce printing artifacts that result from the interactions of two of the printing colors--referred to as moire.

Detailed Description Text (34):
FIG. 8 illustrates the yellow color separation when processed in accordance with the present invention. In particular, the yellow separation was processed using a simple error diffusion technique as described with respect to non-periodic halftone block 152 in FIG. 2. For purposes of comparison, the yellow color separation of FIG. 8 can be combined with the cyan and magenta separations of FIGS. 3 and 4 to illustrate the improved rendition, and elimination of artifacts, in the two-color combinations. Specifically, FIG. 9 represents the two-color separations of cyan and yellow, where yellow is the least perceptible colorant and is processed using a non-periodic rendering technique. Similarly, FIG. 10 represents the two-color combination of magenta and yellow, again having the yellow separation processed using the error diffusion technique previously described. As the result of a comparison of FIG. 6 with FIG. 9 or FIG. 7 with FIG. 10, it will be appreciated by even the casual observer that FIGS. 9 and 10 lack the structural interaction (moire) found in the other figures. Accordingly, the processing of the least visually perceptible color separation reduces the likelihood of two-color moire. Furthermore, the use of such a process expands the latitude of the printing system. To print the halftone dot of one color, say cyan, over the dots of the yellow color separation requires tight control of the xerographic parameters. If the cyan dot is only slightly broken when it is developed on top of the yellow dot, a two-color moire is likely to appear using conventional halftoning methods. However, use of the method and apparatus described herein, a slight imperfection of the cyan dot when placed over a yellow dot is much less likely to cause a visible artifact to appear. Thus, as a result of the present invention the latitude of xerographic or other marking processes can be significantly increased.

Detailed Description Text (35):
In recapitulation, the present invention is a method and apparatus that reduces two-color moire often found during the rendering of full color images using halftoning techniques. The invention relies upon the application of a non-periodic halftone operation to the least perceptible color separation (e.g., yellow) so as to prevent the formation of periodic structures due to the interaction of the yellow colorant with one of the other colorants (e.g., cyan or magenta).

☐ 26. Document ID: US 5661514 A

L7: Entry 26 of 45 File: USPT Aug 26, 1997

DOCUMENT-IDENTIFIER: US 5661514 A
TITLE: Method and apparatus for controlling a thermal print head

Detailed Description Text (6):
Thermal printing can also be characterized by type of image generated. Binary printing occurs where every location on the image is one of two colors. There are no tones or shades of color in binary printing. Areas where coloring occurs are referred to as active areas, and areas where no coloring occurs are referred to as inactive areas. Binary printing is often used for text and line art images. Continuous tone or contone images which are made up of various tones or shades of

color are often printed on binary printing devices by utilizing halftone techniques. These halftone techniques typically utilize a series of halftone cells to render the source image information. By altering the proportion of colored and non-colored areas within the halftone cell, the viewer perceives different tones of color, even though the image is binary in nature when viewed more closely. Thermal printers may also be used to generate contone images by varying the optical density of the media.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☐ 27. Document ID: US 5596352 A

L7: Entry 27 of 45 File: USPT Jan 21, 1997

DOCUMENT-IDENTIFIER: US 5596352 A
TITLE: Printing apparatus and method for printing color boundary regions having reduced color bleed

Detailed Description Text (13):
It will be appreciated that the image will be defined typically on a pixel by pixel basis, and each pixel will be defined by at least one primary color (usually one of the 3 inks). A secondary color for a pixel will have two multiple bit values defining the amounts of two primary colors (e.g., the amounts of 2 different inks to be combined to make the secondary color). For instance, a shade of blue may be a secondary color which is represented as having 45 unit values of cyan and 125 unit values of magenta, where the unit values are the decimal amounts of the primary color over a scale of 0 to 255 possible (this case is often referred to as "8-bit" color since 8 digital bits can define any primary color value from 0 to 255). The methods for rendering an image are well known in the art. The color image is rendered into device pixels by either the host computer or the printer controller using various halftoning techniques. During the rending process, pixels having four color components are converted to pixels having no more than two color components. The resulting image is made up of pixels at the resolution of the ink jet printer, where each of these pixels represents an individual dot of ink to be formed on the surface of the paper. Each of the pixels of the rendered image represents one of eight possible colors to be printed on the paper: cyan, magenta, yellow, red, green, blue, black, and white (where white represents the absence of ink and red, green, and blue are different combinations of cyan, magenta, and/or yellow color overlapping on one pixel). When an image is viewed from a typical viewing distance, the viewer's eye blends the colors of adjacent pixels to produce a variety of possible colors. The data representing the rendered image is stored, usually, in some memory either in the printer or the host computer to which the printer is coupled.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☑ 28. Document ID: US 5543941 A

L7: Entry 28 of 45 File: USPT Aug 6, 1996

DOCUMENT-IDENTIFIER: US 5543941 A
TITLE: Method and apparatus for halftone rendering of a gray image using a blue noise mask

CLAIMS:

9. A method for halftoning a color image by utilizing a pixel-by-pixel comparison of said color image against a first blue noise mask stored in a first memory, comprising the steps of:

a) acquiring said color image to be halftoned to create at least first and second color plane arrays, said acquiring being performed on a pixel-by-pixel basis;

b) storing each of said at least first and second color plane arrays in a second memory;

c) producing a second blue noise mask by shifting the pixels of said first blue noise mask at least one pixel position away from their position in said first blue noise mask;

d) comparing, on a pixel-by-pixel basis, the value of each corresponding pixel in said second blue noise mask and one of said at least first and second color plane arrays to produce a first binary color plane image array;

e) comparing, on a pixel-by-pixel basis, the value of each corresponding pixel in said first blue noise mask and a remaining one of said at least first and second color plane arrays not already compared to a different blue noise mask to produce a second binary color plane image array; and

f) using said first and second binary color plane image arrays in forming a halftoned color image.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 29. Document ID: US 5508727 A

L7: Entry 29 of 45 File: USPT Apr 16, 1996

DOCUMENT-IDENTIFIER: US 5508727 A
TITLE: Apparatus and method for pattern generation on a dielectric substrate

Detailed Description Text (45):
Therefore by using two different color toners which develop opposite polarity charge images, a two-color image may be produced in a single pass. The two-color image may contain any of a continuum of shades of the two colors, in accordance with the techniques for continuous toning described hereinabove, or alternatively, in accordance with the techniques for pseudo halftones described hereinabove. One possible application for this technique is in the generation of "highlight" images.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 30. Document ID: US 5499305 A

L7: Entry 30 of 45 File: USPT Mar 12, 1996

DOCUMENT-IDENTIFIER: US 5499305 A
TITLE: Method and apparatus for coalescing a grayscale image and rendering the coalesced grayscale image as a binary image

CLAIMS:

11. The method for rendering a halftone image from a grayscale pixel of claim 9 wherein identifying a halftone pixel color for each grayscale pixel includes assigning a first pixel color for those grayscale pixel intensities greater than the corresponding lookup table value and assigning a second color for those grayscale pixel intensities that are less than the corresponding lookup table value.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 31. Document ID: US 5270835 A

L7: Entry 31 of 45 File: USPT Dec 14, 1993

DOCUMENT-IDENTIFIER: US 5270835 A
TITLE: Method for forming halftone screen and apparatus therefor

Detailed Description Text (32):
As stated in detail in the foregoing statement, the method of forming a halftone screen according to this invention can expose and scan a light spot of a predetermined size at a predetermined pitch and controls the number of pitches to obtain a desirable number of screen lines when the method is used to form a multi-color separated halftone gradation image which is a combination of all the four colors of C, M, Y and K or of more than two colors out of them. Since the apparatus for control can be simplified by such features, the method can be applied to color scanners of a flat-bed type without using a zooming mechanism.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 32. Document ID: US 5267054 A

L7: Entry 32 of 45 File: USPT Nov 30, 1993

DOCUMENT-IDENTIFIER: US 5267054 A
TITLE: Method and apparatus for the reduction of memory space required for a digital halftone system

Brief Summary Text (5):
The technique of halftoning is widely used in the printing industry for printing continuous tones of images, such as photographs, in a discrete form using a limited number of colors. For example, a monochrome image, such as photographs which appear in newspapers, are represented using two colors, black and white, and are produced typically by generating black dots on white paper. Color images, such as those found in magazines or newspapers, are represented by a small limited number of colors. Halftoning takes advantage of spatial integration in order to generate the image. Spatial integration is performed by the eye when viewing a small area from a large viewing distance wherein the eye averages fine detail within the small area and records only the overall intensity and color of the area.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☐ 33. Document ID: US 5172248 A

L7: Entry 33 of 45 File: USPT Dec 15, 1992

DOCUMENT-IDENTIFIER: US 5172248 A
TITLE: Method for forming halftone screen and apparatus therefor

Detailed Description Text (34):
As stated in detail in the foregoing statement, the method of forming a halftone screen according to this invention can expose and scan a light spot of a predetermined size at a predetermined pitch and controls the number of pitches to obtain a desirable number of screen lines when the method is used to form a multi-color separated halftone gradation image which is a combination of all the four colors of C, M, Y and K or of more than two colors out of them. Since the apparatus for control can be simplified by such features, the method can be applied to color scanners of a flat-bed type without using a zooming mechanism.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☐ 34. Document ID: US 5019896 A

L7: Entry 34 of 45 File: USPT May 28, 1991

DOCUMENT-IDENTIFIER: US 5019896 A
TITLE: Method for forming halftone data

Detailed Description Text (43):
As is described in detail in the foregoing statement, this invention method for forming halftone data can provide a desirable number of screen lines by exposing and scanning a predetermined size of a light spot at a predetermined pitch and by controlling the number of pitches when a multi-colored separated halftone gradation images are formed by combining all of C,M,Y and K or any two or more colors thereof, and prevent occurrence of the tone jumps by re-arranging the dither matrix or screen signals thereof.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☐ 35. Document ID: US 4974171 A

L7: Entry 35 of 45 File: USPT Nov 27, 1990

DOCUMENT-IDENTIFIER: US 4974171 A
TITLE: Page buffer system for an electronic gray-scale color printer

Detailed Description Text (20):
FIG. 7 illustrates the effect of the data contained in the half-byte 87 of the memory block 64 shown in FIG. 6. Bits 89 and 91 contain the binary number "0 1" which indicates that the mode of storage is according to mode B. Bits 93 and 97 contain data which indicates whether the color bytes will be reproduced using halftoned or non-halftoned output techniques. This data is defined by the table 99 shown in FIG. 7. If bits 93 and 97 are both binary "0's", then all three color bytes

will be and will effectively pick colors from the color spectrum 94 in FIG. 6. If the bits 93 and 97 are binary "0" and "1" as indicated in FIG. 7, the first two color bytes will be non-halftoned, and the third color byte will be halftoned. The third condition, which occurs when the binary representation is "1 0", indicates that the first color byte will be non-halftoned and the second and third color bytes will be halftoned. Finally, binary "1's" in both bits 93 and 97 indicate that all three color bytes will be halftoned by the output device and, consequently, will select their colors from color spectrum 95 as shown in FIG. 6.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 36. Document ID: US 4803558 A

L7: Entry 36 of 45 File: USPT Feb 7, 1989

DOCUMENT-IDENTIFIER: US 4803558 A
TITLE: Halftone image estimation methods for dither images

Brief Summary Text (18):
In view of the foregoing, it is an object of the present invention to provide an estimation method for halftone dither images, wherein the scale of a digital electronic circuit which can satisfactorily estimate an original halftone image from a dither image is reduced, and the images are quickly processed. It is another object of the present invention to provide a method which can satisfactorily enlarge or reduce binary images including binary images of characters and line drawings which essentially consist of two colors, black and white, or dither images which express halftones in a pseudoway.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 37. Document ID: US 4736253 A

L7: Entry 37 of 45 File: USPT Apr 5, 1988

DOCUMENT-IDENTIFIER: US 4736253 A
TITLE: Method and apparatus for producing a halftone dot by selectively comparing image signals with highlight and shadow reference values or with halftone dot sub-cell reference values

CLAIMS:

1. A method of producing a halftone dot comprising a predetermined number of halftone dot sub-cells by making each sub-cell (.omega..sub.m l.sub.n) one of two colors, black or white, comprising the steps of:

(a) obtaining a value (C.sub.mn) representative of the density of each of a predetermined number of sections of an original corresponding to the predetermined number of halftone dot sub-cells by scanning the original;

(b-1) making each halftone dot sub-cell (.omega..sub.m l.sub.n) one of said two colors, black or white, when the corresponding value (C.sub.mn) is larger than a first reference value (Hi);

(b-2) making each halftone dot sub-cell (.omega..sub.m l.sub.n) the other of said two colors, white or black, when the corresponding value (C.sub.mn) is smaller than

a second reference value (S);

(b-3) if a value (C.sub.mn) is between the first reference value (Hi) and the second reference value (S), determining whether the corresponding halftone dot sub-cell (.omega..sub.m l.sub.n) is to be black or white by comparing a value (Y) representative of the average density of said predetermined number of sections of said original with a predetermined reference value for the corresponding sub-cell (.omega..sub.m l.sub.n).

3. A method of producing a halftone dot comprising a predetermined number of halftone dot sub-cells by making each sub-cell (.omega..sub.m l.sub.n) one of two colors, black or white, comprising the steps of:

(a) obtaining a value (C.sub.mn) representative of the density of each of a predetermined number of sections of an original corresponding to the predetermined number of halftone dot sub-cells by scanning the original;

(b-1) determining which of the halftone dot sub-cells should be one of said two colors, black or white, by comparing the values (C.sub.mn) with corresponding predetermined halftone dot sub-cell reference values;

(b-2) determining which of the halftone dot sub-cells should be said one of said two colors, black or white, by comparing a value (Y) representative of the average density of said predetermined number of sections of said original with each of said halftone dot sub-cell reference values;

(b-3) comparing numbers (d3) and (d4) of said halftone dot sub-cells which are determined to be said one of said two colors, black or white, in steps (b-1) and (b-2), respectively;

(b-4) if (d3) is not equal to (d4), determining to be said one of said two colors, black or white, a halftone dot sub-cell determined in step (b-1) to be the other of said two colors, white or black, corresponding to one of said predetermined number of sections of said original having a value (C.sub.mn) which is closest to its corresponding predetermined halftone dot sub-cell reference value or determining to be the other of said two colors, white or black, a haltone dot sub-cell determined in step (b-1) to be said one of said two colors, black or white, corresponding to one of said predetermined number of sections of said original having a value (C.sub.mn) which is closest to its corresponding predetermined halftone dot sub-cell reference value until (d3) is equal to (d4);

(b-5) latching a signal representing the color of each of said halftone dot sub-cells as determined in steps (b-1) to (b-4);

(c-1) making each halftone dot sub-cell said one of said two colors, black or white, when the corresponding value (C.sub.mn) is larger than a first reference value (Hi);

(c-2) making each halftone dot sub-cell the other of said two colors, white or black, when the corresponding value (C.sub.mn) is smaller than a second reference value (S);

(c-3) if a value (C.sub.mn) is between the first reference value (Hi) and the second reference value (S), making the corresponding halftone dot sub-cell one of said two colors, black or white, in accordance with the signal latched in step (b-5).

☐ 38. Document ID: US 4672432 A

L7: Entry 38 of 45 File: USPT Jun 9, 1987

DOCUMENT-IDENTIFIER: US 4672432 A
TITLE: Method for recording a color image using dots of colorants of different densities

Abstract Text (1):
A method for reproducing a halftone color image is disclosed, in which each picture element comprises a plurality of cells and one dot is formed for each cell. At least two colorent densities are used for at least some of the colors. When there is more than one combination of colorants which can represent a given density in a picture element, the combination having the largest number of dots is selected. In a preferred embodiment, more colorants of different densities are used for cyan and magenta then are used for black and yellow.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☐ 39. Document ID: US 4081828 A

L7: Entry 39 of 45 File: USPT Mar 28, 1978

DOCUMENT-IDENTIFIER: US 4081828 A
TITLE: Method for halftone reproduction of continuous tone images

Detailed Description Text (27):
Heretofore, the known prior art methods for halftone reproduction in color have required that a screening step be performed prior to the making of the printing plates wherein a different screen angle is used for each of the colors to be printed, as described previously. However, it has been discovered that this screening step does not have to be performed when the method of the present invention is utilized. The recording mediums 24 produced for each color, after being removed from drum 20, may be immediately processed in any conventional manner to produce conventional printing plates for subsequent use in graphic color printing processes, without the necessity of performing a color screening step. The elimination of this step provides a great time savings, as well as the attendant savings in cost, in the production of color halftone reproductions. In addition to providing these savings, the method of the present invention likewise achieves improved tonal density characteristics for the different colors and allows a greater number of tonal densities to be reproduced.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

☐ 40. Document ID: US 3628871 A

L7: Entry 40 of 45 File: USPT Dec 21, 1971

DOCUMENT-IDENTIFIER: US 3628871 A
TITLE: OPTICAL COLOR PRINTING ANALYSIS DEVICE AND METHOD

CLAIMS:

14. A method according to claim 13 in which the halftone sheet comprises three differently colored dot patterns printed in three different subtractive colors with

some of the dots of one subtractive color being printed over portions of dots of a second subtractive color and with some of said dot portions of the second subtractive color printed over areas of dots of a third subtractive color, said method comprising illuminating said sheet and dot patterns with a generally white light which includes color components corresponding to all of said dot and filter colors, the selective positioning of a particular color filter providing an enlarged dark contrast complete image of only that subtractive color dot pattern for which that particular filter color is complementary.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 41. Document ID: EP 812102 A2

L7: Entry 41 of 45 File: EPAB Dec 10, 1997

DOCUMENT-IDENTIFIER: EP 812102 A2
TITLE: Method for halftoning a multi-channel digital color image

Abstract (1):
CHG DATE=19990617 STATUS=O> A method for halftoning a multi-channel digital color image having an x,y array of color pixel values, includes the steps of: providing a matrix of dither values for each color channel of the digital color image wherein two or more of the matrices of dither values are designed jointly to minimize a visual cost function; for each color channel modularly addressing the matrix of dither values with the location of a pixel in the digital color image to obtain an addressed dither value; comparing the addressed dither value for each color channel with the pixel value for the corresponding color channel to determine an output halftone image value for each color channel; and repeating steps b and c for each pixel in the digital image.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 42. Document ID: NA8910194

L7: Entry 42 of 45 File: TDBD Oct 1, 1989

DOCUMENT-IDENTIFIER: NA8910194
TITLE: Halftoning Method for Mosaic Color Displays Using Error Diffusion

Disclosure Text (1):
- The standard method for implementing color on liquid crystal displays, the dominant flat panel technology, is to use a mosaic array of primary color pixels. A careful scheme is required to map the standard image triplet of primary contiguous arrays to the mosaic. This is even more true when basic or practical issues limit the grey level response of the pixels. The following describes such a method based on the mosaic- channeled propagation of round-off errors between pixels. - In recent years it has become clear that few display applications of interest can forego the advantages made possible by (multi)color. The dominant form of electronic display today, the raster-scanned, continuously-refreshed CRT, realizes color well. However, it is more than possible that by the end of this century, this device will have been replaced in most applications by some sort of liquid-crystal light-modulator addressed by a regular matrix. - Color liquid crystal displays have been built by optically co- projecting the image of several valves at the expense of surrendering the compactness which give LCDs their appeal. Frame-sequential color might yet prove practical with LCDs at the expense of tripled switching speeds. However, to date ALL

flat panel LCDs have used a repeating mosaic of color filters to achieve color operation, making examination of this case of primary interest. Study of LCD mosaic color has been reported 1, 2, 3 in the last few years. It is related to the design of single-CRT and single-chip video cameras, which also rely on a color mosaic to encode color information they4Ù. - The problem of color mosaic representation of images has at least two parts: design of a suitable mosaic and choice of a particular mapping scheme between the image and the mosaic. - A method of solving the second problem for a particular solution of the first problem is described. Some examples relate to a repeating color mosaic of three primaries with the following particular nine- pixel repeat pattern: R G B B R G G B R The cited examples assume the pixels are binary, either on or off. Extension of the methods taught herein from this mosaic to others is discussed after the main design examples are explained. - True full-color imaging requires the presence of grey level. Unfortunately, some of the most promising liquid crystal phenomena being explored for liquid crystal display application are rather unamenable to grey level, such as the smectic-C ferroelectric effect of recent great interest. Moreover, even when other methods (such as TFT active matrix) admit grey level in principle, practical considerations of uniformity and yield may greatly limit the number of levels which can be economically achieved. - The representation of grey-level images via media which are inherently amplitude quantized has long been of interest to the information display community. For centruries bilevelism has been an issue in "impact" printing. The methods used to halftone continuous tone images on contemporary all-points-addressable bilevel raster printers have been recently reviewed 5. - The most effective technique is "error diffusion" 6. This method can be applied to the problem of quantization to more than a single bit of amplitude information just as easily as to bilevel. Briefly, it works as follows. It makes a one-to-one correspondence between input and output pixels and quantizes the pixels serially, at least in part. In reducing the number of grey levels between corresponding input and output pixels ("quantizing the input pixel"), a rounding operation is used. The error introduced by this quantization is subtracted from the amplitude values of as-yet unquantized pixels. By relying on the sequential processing of pixels, the rounding error is diffused. The original work 6 describes a particular error propagation matrix with 4 non-zero entries, and subsequent work 5 has suggested alternatives. - Error propagation has been applied to full color (i.e., grey level plus color) images as well 7. One method involves error diffusion within each of three primary planes. More sophisticated techniques use some vector (multi-component) color-space metric to quantize and propagate the vector error. In either case, all methods used to date have assumed the existence of three OVERLAPPING color planes as a target imaging device. Mosaic color has not been addressed in the scientific or patent literature. - Presently, an error propagation method is described which codes full-color images on mosaic color displays with limited grey level response in each pixel. This is most easily done by studying the example outlined above. - One method of quantizing a triplet of contiguous-array color image primaries for a mosaic color display and limited grey response is to use a traditional technique like Floyd-Steinberg error diffusion on each member of the triplet and then map the results to the display by simple decimation filtering so that a given primary component of a pixel is zeroed to additive black if it corresponds to another primary on the mosaic display. Many chromatic artifacts appear in either black-and-white or color images, and this method has been found inferior to the one taught below. - The use of an alternate error diffusion technique which respects the structure of the mosaic display from the outset is preferred. For the diagonal color mosaic structure discussed above, quantization error is propagated only along the constant-color diagonals of the mosaic, from each pixel to its following (diagonal) same-color nearest- neighbor. While error diffusion like this, which uses a single branch, is inferior to methods like Floyd-Steinberg, which propagate error to many branches when one deals with a CONTIGUOUS image array, the former method is superior when one is constrained to use the DISCONTIGOUS array each primary employs in a mosaic color display. - Obviously, the mosaic-sensitive method can be applied to many mosaics other than the diagonal color stripe pattern discussed here, such as mosaics which use rows or columns of constant color, etc. - Usually, image quality can be further improved by spatially low- passing the contiguous primary triplets before doing the diagonal error propagation. A simple low-pass filter, such as one with a flat-topped kernel three pixels wide and one tall, centered on the corresponding output pixel, works substantially as well as more complicated ones. Such a low-pass filter renders all

source pixels equal representation, albeit position fidelity is better for a pixel dominated by the color of the output pixel with which it corresponds. - The use of low-pass filtering before error propagation can be turned on and off dynamically to accommodate the type of object displayed in the various portions of an image. Images of natural objects and simulations usually demand better color fidelity, advocating use of the low-pass filter, whereas the line drawings and text in some computer displays require more spatial fidelity, and low- passing may be ill-advised. Indeed, since in the latter case color is used mainly as a one-of-few tag, it may even be worthwhile to allow some crosstalk between the color primary image triplets constituting the same original pixel. - When one deals with a disply that can manifest several grey levels, the exact details of the error propagation scheme used are less important and a single-branched error propagation technique looks as good as a multi-branched technique. However, this does not imply that multibranching is inconsistent with the mosaic-sensitive propagation methods taught presently. Mosaics, such as the hexagonally-coordinated example below, are open to a branched variation of mosaic-sensitive error propagation because there is more than one (almost) nearest same-colored neighbor quantized subsequent to any given output pixel. In the diagram below, the letter "X" is used to mark a pixel and its (almost) nearest neighbors. - R G B R G X R G B B R G X R G X R G R G B R G X R G B B R G X R G X R G B R G X R G B The introduction of branching allows one to add a random variation to the branching to further suppress halftoning artifacts 8. - A color mosaic intrinsically leads to some "color misconvergence", even if pixels are small enough that the inferior localization abilities of the chromatic aspect of the human visual system lead to no subjective quality loss. When this effect cannot be neglected, one can borrow a lenseless defocusing technique well-known to manufacturers of color-mosaic cameras. A thin diffusing surface held a small distance above the image plane can serve as a simple, inexpensive, low-pass optical filter which serves to blur multi-primary neighbors into one another, providing a functin which complements, rather than replaces the electronic low-pass filtering described above. - References: 1 S. Tsuruta, K. Mitsuhashi, S. Ichikawa and K. Noguchi, "Color Pixel Arrangement Evaluation for LC-TV," Proc. 1985 International Display Research Conference, pp. 24-26 (1985). 2 T. L. Benzschawel and W. E. Howard, "Color Pixel Geometrics and Image Quality," IBM Research Report RC12514 (February 1987). 3 V. Cordonnier, "An Evaluation of Some Three-Color Tiling Patterns," IBM Research Report RC12897 (June 1988). 4 K. Knop, "Computer Simulation of Single-Chip Color Cameras," Journal of Imaging Technology 12, (5), 267-270 (October 1986). 5 G. S. Fawcett and G. F. Schrack, "Halftoning Techniques Using Error Correction," Proceedings of the SID 27, (4), 305-308 (1986). 6 R. W. Floyd and L. Steinberg, "An Adaptive Algorithm for Spatial Greyscale," Proceedings of the SID 17, 2 75-77 (1976). 7 P. H. Jackson, "The IAX Image Processing System: Reference Manual," IBM Research Report UKSC125 (May 1985). 8 G. Goertzel and G. R. Thompson, "Digital Halftoning on the IBM 4250 Printer," IBM Journal of Research and Development 31, (1), 2-15 (January 1987).

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 43. Document ID: EP 887998 A2 US 5949965 A JP 11010918 A

L7: Entry 43 of 45 File: DWPI Dec 30, 1998

DERWENT-ACC-NO: 1999-048324
DERWENT-WEEK: 199943

TITLE: Halftoning technique e.g. for inkjet printers - having printed dots of two or more colours dispersed so as to avoid noticeable clumping of dots

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 44. Document ID: EP 732843 B1 EP 732843 A2 JP 08279920 A CA 2169902 A EP 732843 A3 US 5973803 A US 6363172 B1

L7: Entry 44 of 45 File: DWPI Sep 11, 2002

DERWENT-ACC-NO: 1996-414794
DERWENT-WEEK: 200264

TITLE: Combined colour halftoning method for use in colour printers and displays - combining number of dots of each primary colourant to form output display level having different colourant dots which are homogeneously distributed

Basic Abstract Text (1):
The combined colour halftoning method involves determining a value of the signals representing each of the input pixels of each of two colour planes. The determined value of each of the signals representing each of input pixels of each of the colour planes are used in conjunction with each other to determine if one of the colours is to be used in the output representation for a specific input pixel of each of the colour planes.

Equivalent Abstract Text (1):
The combined colour halftoning method involves determining a value of the signals representing each of the input pixels of each of two colour planes. The determined value of each of the signals representing each of input pixels of each of the colour planes are used in conjunction with each other to determine if one of the colours is to be used in the output representation for a specific input pixel of each of the colour planes.

Equivalent Abstract Text (5):
The combined colour halftoning method involves determining a value of the signals representing each of the input pixels of each of two colour planes. The determined value of each of the signals representing each of input pixels of each of the colour planes are used in conjunction with each other to determine if one of the colours is to be used in the output representation for a specific input pixel of each of the colour planes.

Equivalent Abstract Text (9):
The combined colour halftoning method involves determining a value of the signals representing each of the input pixels of each of two colour planes. The determined value of each of the signals representing each of input pixels of each of the colour planes are used in conjunction with each other to determine if one of the colours is to be used in the output representation for a specific input pixel of each of the colour planes.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw. Desc | Image

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☐ 45. Document ID: DE 3438496 A DE 3438496 C GB 2150783 A GB 2150783 B JP 60132465 A US 4736253 A

L7: Entry 45 of 45 File: DWPI Jun 13, 1985

DERWENT-ACC-NO: 1985-147463
DERWENT-WEEK: 198525

TITLE: Half tone image production system - compares density value voltages for colour computing circuit with reference voltages to form black or white cells

Equivalent Abstract Text (4):
A method of producing a halftone dot comprising a number of halftone dot sub-cells

by making each sub-cell one of two colours, black or white, comprising the steps of: (a) obtaining a value (Cmn) representative of a density of each section of an original corresponding to the halftone dot sub-cell by scanning the original; (b) making the corresponding halftone dot sub-cell (Wm1n) one of said two colours, black or white, when the value (Cmn) is larger than a first reference value (Hi); (b-2) making the corresponding halftone dot sub-cell (wm1n) the other of said two colours, white or black, when the value (Cmn) is smaller than a second reference value (S); (b-3) when the value (Cmn) is between the first reference value and the second reference value (S), determining whether the corresponding halftone dot sub-cell (wm1n) is to be black or white by comparing a value (Y) representative of average density of a picture element which includes a section with a predetermined reference signal for the sub-cell (wm1n).y

Term	Documents
SECOND.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4026119
SECONDS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	350463
TWO.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	5300181
TWOES	0
TWOS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2434
TWOE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	13
SUBSEQUENT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	861733
SUBSEQUENTS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	21
TECHNIQ$5	0
TECHNIQ.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	69
TECHNIQAE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
(((TECHNIQ$5 OR METHOD$5 OR ARRAY$5 OR THRESHOLD$5) NEAR2 HALFTON$3) SAME ((COLOR$3 OR COLOUR$3) NEAR2 (SECOND OR TWO OR SUCCE$5 OR SUBSEQUENT OR SEQUEN$5))).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	45

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☐ 1. Document ID: US 20020102468 A1

L2: Entry 1 of 19 File: PGPB Aug 1, 2002

DOCUMENT-IDENTIFIER: US 20020102468 A1
TITLE: Method of forming an improved attenuated phase-shifting photomask

Summary of Invention Paragraph (7):
[0005] The electron-beam (E-beam) double exposure method of halftone APSMs causes overexposure for large exposed areas, especially in the letters' pattern and the frame pattern. Letters are used to identify individual photomasks so they may be traced for quality control measures. This causes chromium (Cr) and attenuator material loss in the subsequent steps of the double exposure method of halftone APSM formation leading to, for example, many pinholes and nuisance defects that are then discovered during photomask inspection.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

☑ 2. Document ID: US 20020080098 A1

L2: Entry 2 of 19 File: PGPB Jun 27, 2002

DOCUMENT-IDENTIFIER: US 20020080098 A1
TITLE: Method of driving a plasma display panel

Abstract Paragraph (1):
A method of displaying a halftone image on a PDP display unit by using a frame division technique, the method comprising selecting display lines whose number is identical to the total number of said divided subfields, addressing for designating pixels of selected display lines to be displayed and displaying each subfield allocated for the said selected display lines; shifting by a predetermined number of display lines from said selected display lines for at least a sustain pulse period unit, selecting display lines, addressing for designating pixels to be displayed and displaying each subfield allocated for the said selected display lines; and repeating said shifting, said selecting, said addressing and said displaying steps until each of the subfields is completely displayed for all display lines; wherein display lines for which all subfields of one frame have been completely displayed for an idle period. According to the present invention, there is provided a driving method capable of preventing images in two frames from being viewed overlapped to a viewer when displaying a dynamic image by clarifying a boundary between adjacent frames in a multi-scan driving method within a sustaining pulse period.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

☐ 3. Document ID: US 6476934 B1

L2: Entry 3 of 19 File: USPT Nov 5, 2002

DOCUMENT-IDENTIFIER: US 6476934 B1
TITLE: Geometrically reducing influence halftoning

Detailed Description Text (116):
In a further embodiment of FFH, adapted from the first and second embodiments, force field halftoning can be combined with any other method of halftoning to halftone one or more images or image frames.

Detailed Description Text (117):
That is, firstly the output value of the current pixel 11 of an image frame is determined by any method of halftoning. Then, similarly to the first and second embodiments of FFH, that output value is accepted if the repulsive force associated with that output value of the current pixel is less than the sum of the minimum repulsive force achievable for any output value of the current pixel and a threshold value. In the event that the predetermined output value is not accepted, then the output value of the pixel is assigned an output value which provides the minimum achievable repulsive force for the pixel.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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☐ 4. Document ID: US 6432588 B1

L2: Entry 4 of 19 File: USPT Aug 13, 2002

DOCUMENT-IDENTIFIER: US 6432588 B1
TITLE: Method of forming an improved attenuated phase-shifting photomask

Brief Summary Text (7):
The electron-beam (E-beam) double exposure method of halftone APSMs causes overexposure for large exposed areas, especially in the letters' pattern and the frame pattern. Letters are used to identify individual photomasks so they may be traced for quality control measures. This causes chromium (Cr) and attenuator material loss in the subsequent steps of the double exposure method of halftone APSM formation leading to, for example, many pinholes and nuisance defects that are then discovered during photomask inspection.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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☐ 5. Document ID: US 6310651 B1

L2: Entry 5 of 19 File: USPT Oct 30, 2001

DOCUMENT-IDENTIFIER: US 6310651 B1
TITLE: Data processing method and device for use in display apparatus

Detailed Description Text (19):
However, application of such pseudo halftone processing to a display apparatus calls for taking precautions. Video data sent to the display apparatus has various formats. Especially, the order of data transfer is important. For example, a TV image is sent in Japan in accordance with the NTSC system by 2:1 interlaced scanning (interlaced scanning of one frame per two fields. Frame frequency: 30 Hz/field frequency: 60 Hz). Pseudo halftone processing of such data cannot be performed in

real time. In most halftone processing techniques except for the general dither method, data from adjacent peripheral pixels must be reflected in determination of the bright/dark state of a given pixel. When pseudo halftone processing of video data such as a TV image corresponding to one field, which is sent every field by interlaced scanning, is performed in real time, error data does not properly propagate to pixels (pixels on an adjacent scanning line) to which the error data should be reflected in one frame, so a proper halftone-processed image can hardly be obtained. After the even and odd fields of video data sent by interlaced scanning are formed into one frame, halftone processing must be sequentially performed from the upper portion of the screen by non-interlaced scanning.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWMC | Draw Desc | Image

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☐ 6. Document ID: US 6124844 A

L2: Entry 6 of 19 File: USPT Sep 26, 2000

DOCUMENT-IDENTIFIER: US 6124844 A
TITLE: Force field halftoning

Detailed Description Text (58):
In a further embodiment, adapted from the second and third embodiments, force field halftoning can be combined with any other method of halftoning to halftone one or more images or image frames.

Detailed Description Text (59):
That is, firstly the output value of the current pixel 11 of an image frame is determined by any method of halftoning. Then, similarly to the second and third embodiments, that output value is accepted if the repulsive force associated with that output value of the current pixel is less than the sum of the minimum repulsive force achievable for any output value of the current pixel and a threshold value. In the event that the predetermined output value is not accepted, then the output value of the pixel is assigned an output value which provides the minimum achievable repulsive force for the pixel.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWMC | Draw Desc | Image

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☐ 7. Document ID: US 6020897 A

L2: Entry 7 of 19 File: USPT Feb 1, 2000

DOCUMENT-IDENTIFIER: US 6020897 A
TITLE: Dehalftoning of digital images

Abstract Text (1):
Methods and apparatus for blending graphics objects. In one aspect, a method includes receiving a first graphics object; rendering the first graphics object to produce a first pixel map having a first bit depth; increasing a bit depth of a second pixel map associated with a second graphics object that is to be blended with the first graphics object, where the second bit depth is less than the first bit depth; and blending the first and second pixel maps. The method may be implemented to blend graphics objects received by a printing device. In one embodiment, the invention features blending deep pixel data received by a printing device with corresponding shallow halftoned data stored in a shallow frame buffer. The invention may be implemented as a printer configured to receive a page description language

description of a page to be printed, the printer including a dehalftone engine for deriving deep pixel data values for objects stored in a shallow frame buffer. In another aspect, the invention features using a pixelmap representative of underlying graphics data for transfer between a host and a remote device by transmitting a halftone representation of the pixelmap from the host to the remote device and reconstructing the pixelmap at the remote device from the halftone representation and a threshold matrix.

Brief Summary Text (8):
Image data stored in the frame buffer may be deep or shallow. The depth refers to the number of bits required to represent a single pixel in the output image. For the purposes of these discussions, a one bit deep frame buffer, referred to as a shallow frame buffer, represents each pixel in an output image with one bit (on or off, where the on and off bit values correspond to the existence or absence of a given color in the output image, typically black or white). Again for the purposes of these discussions a two or more bit deep frame buffer, referred to as a deep frame buffer, represents each pixel in an output image with two or more bits. The actual bit depth of shallow and deep pixel data depends on the specific implementation. The distinction between the two is that shallow pixel data are represented by fewer bits per pixel than are deep pixel data bits and that shallow frame buffer data is created by transforming the deep pixel data (color or gray values). The transformation of deep pixel data into shallow pixel data may be accomplished by numerous methods including halftoning or dithering. For the purposes of these discussions, an example of a halftoning transformation will be described. Those ordinarily skilled in the art will recognize that other transformation techniques are equally well suited to the inventive processes described herein. In a color printer, shallow or deep frame buffers may be used for each color component in an output image. For example, a 1 bit frame buffer in a color printer results in 1 bit per color component for the output image.

☐ 8. Document ID: US 5930396 A

L2: Entry 8 of 19 File: USPT Jul 27, 1999

DOCUMENT-IDENTIFIER: US 5930396 A
TITLE: Method and apparatus for generating halftone output

Abstract Text (1):
A method of generating halftone output on an output device. The method includes retrieving at least one table which associates gray levels with halftone results for a region of an output frame including more than one pixel, determining a reference gray level for a tile of an output frame including more than one pixel, using the at least one table to determine a halftone result for the reference gray level, storing the halftone result for the reference gray level to the tile of the output frame, and delivering the output frame to the output device. The table may be generated from a set of thresholds, which may be a threshold array. A first table may associates gray levels with codes and a second table may associates codes with halftone results, and the method may include converting the reference gray level to a reference code with the first table and converting the reference code to the halftone result for the reference gray level with the second table. Converting the reference gray level to a code may occur during a front-end interpretation and converting the reference code to the halftone result may occur during a back-end rendering.

Brief Summary Text (66):
In general, in another aspect, the invention provides a method of generating halftone output on an output device. The method includes receiving an image; dividing an output frame into a plurality of tiles, each tile including more than

one pixel; retrieving a first plurality of tables which associate gray levels with codes; retrieving a second plurality of tables which associate codes with halftone results for regions including more than one pixel; for each tile, selecting one table from the plurality of first tables and one table from the plurality of second tables based on the position of the tile in the output frame, determining a reference gray level based on the portion of the image corresponding to the position of the tile in the output frame, using the selected table from the first plurality of tables to convert the reference gray level to a code, using the selected table from the second plurality of tables to convert the code to a halftone result, and storing the halftone result to the tile of the output frame; and delivering the output frame to the output device.

☐ 9. Document ID: US 5907316 A

L2: Entry 9 of 19 File: USPT May 25, 1999

DOCUMENT-IDENTIFIER: US 5907316 A
TITLE: Method of and apparatus for displaying halftone images

Detailed Description Text (29):
A first aspect of the present invention provides a method of displaying a halftone image on a display unit according to a frame division technique that divides each frame of the halftone image into subframes each having an addressing period and a specific sustain discharge period to provide a specific intensity level. When displaying dynamic halftone images, the method differs the position of each frame of image on the display unit from subframe to subframe. More precisely, the method successively advances the position of each dynamic image on the display unit from subframe to subframe between a first position determined by display data provided for a given frame and a second position determined by display data provided for the next frame. The method determines the position of the dynamic image in each subframe according to a motion vector set between the first and second positions.

Detailed Description Text (88):
As explained above, the second embodiment of the first aspect of the present invention provides a method of displaying a halftone image on a display unit according to a frame division technique that divides each frame of the halftone image into subframes each having an addressing period and a specific sustain discharge period to provide a specific intensity level. If combinations of subframes to realize different intensity levels between frames of a dynamic halftone image produce a bright part, the second embodiment disables some of the subframes, thereby canceling the bright part, and if they produce a dark part, the second embodiment additionally enables some subframes, thereby canceling the dark part.

Detailed Description Text (117):
The first principle of the second aspect of the present invention provides a method of displaying a halftone image on a display unit with each frame of the halftone image having subframes that have individual intensity levels and are combined to provide a required intensity level. The method includes the step of enabling an intensity level adjusting subframe in the subframes of one of consecutive frames that involve a change in intensity level between them, to substantially satisfy an expression of S1.ltoreq.S2+.DELTA.S.ltoreq.S3, or S1.gtoreq.S2+.DELTA.S.gtoreq.S3, where S1 is an average of B(t), which is a temporal change in a stimulus on the human eye, before the change of intensity level, S2 is an average of B(t) during the change of intensity level, S3 is an average of B(t) after the change of intensity level, and .DELTA.S is an average of a temporal change in a stimulus on the human eye due to the intensity level adjusting subframe.

Detailed Description Text (129):

As explained above, the second principle of the second aspect of the present invention provides a method of displaying a halftone image on a display unit with each frame of the halftone image having subframes that have individual intensity levels and are combined to provide a required intensity level. The method includes the step of disabling an intensity level adjusting subframe in the subframes of one of consecutive frames that display different intensity levels, to substantially satisfy an expression of S1.ltoreq.S2-.DELTA.S.ltoreq.S3 or S1.gtoreq.S2-.DELTA.S.gtoreq.S3, where S1 is an average of B(t), which is a temporal change in a stimulus on the human eye, before the change of intensity level, S2 is an average of B(t) during the change of intensity level, S3 is an average of B(t) after the change of intensity level, and .DELTA.S is an average of a temporal change in a stimulus on the human eye due to the intensity level adjusting subframe.

CLAIMS:

24. A method of displaying a halftone image as claimed in claim 23, wherein the subframes of each frame are arranged such that one having the highest intensity level and one having the second highest intensity level are not adjacent to each other.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 10. Document ID: US 5680526 A

L2: Entry 10 of 19 File: USPT Oct 21, 1997

DOCUMENT-IDENTIFIER: US 5680526 A
TITLE: Method and system for selectively rendering image data in a bi-level or multi-level format

Brief Summary Text (13):
In the past, it has been possible to configure multilevel output devices to act as bi-level devices. In such a mode of operation, only a single bit per pixel is stored in the frame buffer. A smaller and simpler frame buffer can be used, and rendering time decreases proportionately to the pixel depth. This approach has two significant disadvantages, however. First, it requires explicit intervention by the user. Secondly, when configured as a bi-level device, it is impossible for the device to display intermediate shades of gray or color directly. Rather, a method such as halftoning must be employed.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 11. Document ID: US 5581295 A

L2: Entry 11 of 19 File: USPT Dec 3, 1996

DOCUMENT-IDENTIFIER: US 5581295 A
TITLE: Method and apparatus for resequencing image data for a printhead

Detailed Description Text (29):
The above discussion is directed to operation of the printer and printer control system in a two-bits per pixel grey level mode wherein a source of raw image data is obtained by scanning an image on an original document using a CCD or other device or

obtaining such information from a computer file. The raw data is processed as is typical by subjecting same to various image processing algorithms, i.e., thresholding, halftone generation, error diffusion suited for output on a rasterized image data signal to a grey level printhead. Thus, a multibit digital data signal from a document scanner can be subjected to thresholding by comparing same to say three fixed threshold values to determine a two-bit grey level signal for such data signal. The two-bit signal comprises a more significant bit (MSB) and a less significant bit (LSB). As noted above, the two-bits are separated and processed by essentially similar separate processing paths or circuits wherein each bit that is associated with the same document is subjected to compression, storage, expansion and then stitched with the corresponding other bit of that pixel for input to an LUT to determine the corresponding corrected grey level data signal for recording that pixel by the particular LED that is to be used to record same. As used herein, pixels associated with a document refer, not necessarily to all pixels on a document original or a printed copy thereof, but to all pixels that are to be printed on a single image frame of the printer apparatus. Thus, where a printed document is to be produced and wherein the sheet includes different colors, the printer apparatus could record portions of the image on different image frames and develop such image frames, respectively, with differently colored toners and transfer the two or more developed images in register to a receiver sheet to form a composite plural color image.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWMC | Draw Desc | Image

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☐ 12. Document ID: US 5479188 A

L2: Entry 12 of 19 File: USPT Dec 26, 1995

DOCUMENT-IDENTIFIER: US 5479188 A
TITLE: Method for driving liquid crystal display panel, with reduced flicker and with no sticking

Brief Summary Text (7):
Here, a liquid crystal display driving method for displaying a halftone image in accordance with a conventional frame thinning out system, will be described with reference to FIGS. 1A to 1C and 2. FIGS. 1A to 1C show a change in brightness for images having different gradation levels, and FIG. 2 illustrates a distribution of brightness in a display region composed of pixels arranged in two rows and two columns.

Brief Summary Text (15):
The halftone display method as shown in FIG. 3 of displaying one halftone by use of two frames, is called a two-frame thinning out system.

Brief Summary Text (16):
However, in the halftone display method in accordance with the conventional two-frame thinning out system, the voltage applied in the odd-numbered frames (Frames 1, 3, 5, . . .) is asymmetric to the voltage applied in the even-numbered frames (Frames 2, 4, . . .). Therefore, a direct current voltage is applied to the liquid crystal, with the result that an image sticking occurs and furthermore, the lifetime of the liquid display is reduced.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWMC | Draw Desc | Image

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☐ 13. Document ID: US 5384646 A

L2: Entry 13 of 19 File: USPT Jan 24, 1995

DOCUMENT-IDENTIFIER: US 5384646 A
TITLE: Marking engine for grey level printing having a high productivity image data processing mode

Detailed Description Text (29):
The above discussion is directed to operation of the printer and printer control system in a two-bits per pixel grey level mode wherein a source of raw image data is obtained by scanning an image on an original document using a CCD or other device or obtaining such information from a computer file. The raw data is processed as is typical by subjecting same to various image processing algorithms, i.e., thresholding, halftone generation, error diffusion suited for output on a rasterized image data signal to a grey level printhead. Thus, a multibit digital data signal from a document scanner can be subjected to thresholding by comparing same to say three fixed threshold values to determine a two-bit grey level signal for such data signal. The two-bit signal comprises a more significant bit (MSB) and a less significant bit (LSB). As noted above, the two-bits are separated and processed by essentially similar separate processing paths or circuits wherein each bit that is associated with the same document is subjected to compression, storage, expansion and then stitched with the corresponding other bit of that pixel for input to an LUT to determine the corresponding corrected grey level data signal for recording that pixel by the particular LED that is to be used to record same. As used herein, pixels associated with a document refer, not necessarily to all pixels on a document original or a printed copy thereof, but to all pixels that are to be printed on a single image frame of the printer apparatus. Thus, where a printed document is to be produced and wherein the sheet includes different colors, the printer apparatus could record portions of the image on different image frames and develop such image frames, respectively, with differently colored toners and transfer the two or more developed images in register to a receiver sheet to form a composite plural color image.

☐ 14. Document ID: US 5367383 A

L2: Entry 14 of 19 File: USPT Nov 22, 1994

DOCUMENT-IDENTIFIER: US 5367383 A
TITLE: Method and apparatus for maximizing data storage in a processor of image data

Detailed Description Text (29):
The above discussion is directed to operation of the printer and printer control system in a two-bits per pixel grey level mode wherein a source of raw image data is obtained by scanning an image on an original document using a CCD or other device or obtaining such information from a computer file. The raw data is processed as is typical by subjecting same to various image processing algorithms, i.e., thresholding, halftone generation, error diffusion suited for output on a rasterized image data signal to a grey level printhead. Thus, a multibit digital data signal from a document scanner can be subjected to thresholding by comparing same to say three fixed threshold values to determine a two-bit grey level signal for such data signal. The two-bit signal comprises a more significant bit (MSB) and a less significant bit (LSB). As noted above, the two-bits are separated and processed by essentially similar separate processing paths or circuits wherein each bit that is associated with the same document is subjected to compression, storage, expansion and then stitched with the corresponding other bit of that pixel for input to an LUT to determine the corresponding corrected grey level data signal for recording that pixel by the particular LED that is to be used to record same. As used herein, pixels associated with a document refer, not necessarily to all pixels on a document

original or a printed copy thereof, but to all pixels that are to be printed on a single image frame of the printer apparatus. Thus, where a printed document is to be produced and wherein the sheet includes different colors, the printer apparatus could record portions of the image on different image frames and develop such image frames, respectively, with differently colored toners and transfer the two or more developed images in register to a receiver sheet to form a composite plural color image.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 15. Document ID: US 3647471 A

L2: Entry 15 of 19 File: USPT Mar 7, 1972

DOCUMENT-IDENTIFIER: US 3647471 A
TITLE: PHOTOGRAPHIC REPRODUCTION OF HALFTONE SCREENS

Detailed Description Text (5):
The photographic master may now be used to produce a halftone screen in accordance with the method of the invention. To produce a halftone screw from a pair of glass orthochromatic plates, one such plate 50 is placed in a vacuum frame, with its photosensitive emulsion 54 side up. The plate 50 is of the standard and well-known type used in professional photography. The photographic master 14 produced in the manner described in the preceding paragraph is placed upon the plate 50, emulsion side down. Remove the air from the vacuum frame. The vacuum frame may be of any suitable and well-known construction, such as is conventionally used in making photolitho plates and the like. Expose the master 14 and plate 50 to a light source. The type of light source or time of exposure is a matter of choice, it only being required that complete exposure occur, not insufficient or excess exposure. Insufficient exposure will cause the lines to be thin and light in color. Excess exposure will cause the lines to become blurred and not definite at the edges. Open the vacuum frame to the air and remove the photographic master and the exposed orthochromatic plate 50. Develop the plate by conventional methods and dry. A second glass orthochromatic plate 52 is then prepared in the manner just described. The pair of plates thus formed, and having identical line ruling, are then combined into an integral structure. To accomplish this, place the first plate 50 in a wooden rack with the emulsion 54 side up. Cover the plate 50 with a transparent adhesive such as Canada Fir Balsam (Balsam has substantially the same index of refraction as glass). Place the second plate 52 on top of the Balsam with emulsion 56 side down. Press out excess Balsam and let dry until the plates 50 and 52 are cemented together. Remove the plates 50 and 52 from the rack and place a metal binding around all four edges of the resulting halftone screen. The screen is now ready for use.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 16. Document ID: JP 2002140050 A

L2: Entry 16 of 19 File: JPAB May 17, 2002

DOCUMENT-IDENTIFIER: JP 2002140050 A
TITLE: DRIVING METHOD FOR LIQUID CRYSTAL DISPLAY PANEL

Abstract (2):
SOLUTION: In a simple matrix type liquid crystal display panel, a liquid crystal layer is held between a row electrode group and a column electrode group to provide

pixels in a matrix manner. The panel is driven by a multigradation display driving method in accordance with given pixel data. When frame modulation is conducted for every row and the rows are turned ON and OFF for every other row by a halftone level by the method, a selected row is selected for every other row. For the case of this non-distributed type 4 MLA method driving, the number of changes in the column electrode waveforms becomes two in a frame. This number is greatly reduced compared with N times changes of a conventional non-distributed type 4 MLA method driving.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 17. Document ID: WO 9848567 A2

L2: Entry 17 of 19 File: EPAB Oct 29, 1998

DOCUMENT-IDENTIFIER: WO 9848567 A2
TITLE: HIGH-SPEED HALFTONING

Abstract (1):
A method of generating halftone output on an output device. The method includes retrieving at least one table which associates gray levels with halftone results for a region of an output frame including more than one pixel, determining a reference gray level for a tile of an output frame including more than one pixel, using the at least one table to determine a halftone result for the reference gray level, storing the halftone result for the reference gray level to the tile of the output frame, and delivering the output frame to the output device. The table may be generated from a set of thresholds, which may be a threshold array. A first table may associate gray levels with codes and a second table may associate codes with halftone results, and the method may include converting the reference gray level to a reference code with the first table and converting the reference code to the halftone result for the reference gray level with the second table. Converting the reference gray level to a code may occur during a front-end interpretation and converting the reference code to the halftone result may occur during a back-end rendering.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments KWIC | Draw Desc | Image

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☐ 18. Document ID: NA8910194

L2: Entry 18 of 19 File: TDBD Oct 1, 1989

DOCUMENT-IDENTIFIER: NA8910194
TITLE: Halftoning Method for Mosaic Color Displays Using Error Diffusion

Disclosure Text (1):
- The standard method for implementing color on liquid crystal displays, the dominant flat panel technology, is to use a mosaic array of primary color pixels. A careful scheme is required to map the standard image triplet of primary contiguous arrays to the mosaic. This is even more true when basic or practical issues limit the grey level response of the pixels. The following describes such a method based on the mosaic- channeled propagation of round-off errors between pixels. - In recent years it has become clear that few display applications of interest can forego the advantages made possible by (multi)color. The dominant form of electronic display today, the raster-scanned, continuously-refreshed CRT, realizes color well. However, it is more than possible that by the end of this century, this device will have been replaced in most applications by some sort of liquid-crystal light-modulator

addressed by a regular matrix. - Color liquid crystal displays have been built by optically co- projecting the image of several valves at the expense of surrendering the compactness which give LCDs their appeal. Frame-sequential color might yet prove practical with LCDs at the expense of tripled switching speeds. However, to date ALL flat panel LCDs have used a repeating mosaic of color filters to achieve color operation, making examination of this case of primary interest. Study of LCD mosaic color has been reported 1, 2, 3 in the last few years. It is related to the design of single-CRT and single-chip video cameras, which also rely on a color mosaic to encode color information they4Ù. - The problem of color mosaic representation of images has at least two parts: design of a suitable mosaic and choice of a particular mapping scheme between the image and the mosaic. - A method of solving the second problem for a particular solution of the first problem is described. Some examples relate to a repeating color mosaic of three primaries with the following particular nine- pixel repeat pattern: R G B B R G G B R The cited examples assume the pixels are binary, either on or off. Extension of the methods taught herein from this mosaic to others is discussed after the main design examples are explained. - True full-color imaging requires the presence of grey level. Unfortunately, some of the most promising liquid crystal phenomena being explored for liquid crystal display application are rather unamenable to grey level, such as the smectic-C ferroelectric effect of recent great interest. Moreover, even when other methods (such as TFT active matrix) admit grey level in principle, practical considerations of uniformity and yield may greatly limit the number of levels which can be economically achieved. - The representation of grey-level images via media which are inherently amplitude quantized has long been of interest to the information display community. For centruries bilevelism has been an issue in "impact" printing. The methods used to halftone continuous tone images on contemporary all-points-addressable bilevel raster printers have been recently reviewed 5. - The most effective technique is "error diffusion" 6. This method can be applied to the problem of quantization to more than a single bit of amplitude information just as easily as to bilevel. Briefly, it works as follows. It makes a one-to-one correspondence between input and output pixels and quantizes the pixels serially, at least in part. In reducing the number of grey levels between corresponding input and output pixels ("quantizing the input pixel"), a rounding operation is used. The error introduced by this quantization is subtracted from the amplitude values of as-yet unquantized pixels. By relying on the sequential processing of pixels, the rounding error is diffused. The original work 6 describes a particular error propagation matrix with 4 non-zero entries, and subsequent work 5 has suggested alternatives. - Error propagation has been applied to full color (i.e., grey level plus color) images as well 7. One method involves error diffusion within each of three primary planes. More sophisticated techniques use some vector (multi-component) color-space metric to quantize and propagate the vector error. In either case, all methods used to date have assumed the existence of three OVERLAPPING color planes as a target imaging device. Mosaic color has not been addressed in the scientific or patent literature. - Presently, an error propagation method is described which codes full-color images on mosaic color displays with limited grey level response in each pixel. This is most easily done by studying the example outlined above. - One method of quantizing a triplet of contiguous-array color image primaries for a mosaic color display and limited grey response is to use a traditional technique like Floyd-Steinberg error diffusion on each member of the triplet and then map the results to the display by simple decimation filtering so that a given primary component of a pixel is zeroed to additive black if it corresponds to another primary on the mosaic display. Many chromatic artifacts appear in either black-and-white or color images, and this method has been found inferior to the one taught below. - The use of an alternate error diffusion technique which respects the structure of the mosaic display from the outset is preferred. For the diagonal color mosaic structure discussed above, quantization error is propagated only along the constant-color diagonals of the mosaic, from each pixel to its following (diagonal) same-color nearest- neighbor. While error diffusion like this, which uses a single branch, is inferior to methods like Floyd-Steinberg, which propagate error to many branches when one deals with a CONTIGUOUS image array, the former method is superior when one is constrained to use the DISCONTIGOUS array each primary employs in a mosaic color display. - Obviously, the mosaic-sensitive method can be applied to many mosaics other than the diagonal color stripe pattern discussed here, such as mosaics which use rows or columns of constant color, etc. - Usually, image quality can be further improved by spatially

low- passing the contiguous primary triplets before doing the diagonal error propagation. A simple low-pass filter, such as one with a flat-topped kernel three pixels wide and one tall, centered on the corresponding output pixel, works substantially as well as more complicated ones. Such a low-pass filter renders all source pixels equal representation, albeit position fidelity is better for a pixel dominated by the color of the output pixel with which it corresponds. - The use of low-pass filtering before error propagation can be turned on and off dynamically to accommodate the type of object displayed in the various portions of an image. Images of natural objects and simulations usually demand better color fidelity, advocating use of the low-pass filter, whereas the line drawings and text in some computer displays require more spatial fidelity, and low- passing may be ill-advised. Indeed, since in the latter case color is used mainly as a one-of-few tag, it may even be worthwhile to allow some crosstalk between the color primary image triplets constituting the same original pixel. - When one deals with a disply that can manifest several grey levels, the exact details of the error propagation scheme used are less important and a single-branched error propagation technique looks as good as a multi-branched technique. However, this does not imply that multibranching is inconsistent with the mosaic-sensitive propagation methods taught presently. Mosaics, such as the hexagonally-coordinated example below, are open to a branched variation of mosaic-sensitive error propagation because there is more than one (almost) nearest same-colored neighbor quantized subsequent to any given output pixel. In the diagram below, the letter "X" is used to mark a pixel and its (almost) nearest neighbors. - R G B R G X R G B B R G X R G X R G R G B R G X R G B B R G X R G X R G R G B R G X R G B The introduction of branching allows one to add a random variation to the branching to further suppress halftoning artifacts 8. - A color mosaic intrinsically leads to some "color misconvergence", even if pixels are small enough that the inferior localization abilities of the chromatic aspect of the human visual system lead to no subjective quality loss. When this effect cannot be neglected, one can borrow a lenseless defocusing technique well-known to manufacturers of color-mosaic cameras. A thin diffusing surface held a small distance above the image plane can serve as a simple, inexpensive, low-pass optical filter which serves to blur multi-primary neighbors into one another, providing a functin which complements, rather than replaces the electronic low-pass filtering described above. - References: 1 S. Tsuruta, K. Mitsuhashi, S. Ichikawa and K. Noguchi, "Color Pixel Arrangement Evaluation for LC-TV," Proc. 1985 International Display Research Conference, pp. 24-26 (1985). 2 T. L. Benzschawel and W. E. Howard, "Color Pixel Geometrics and Image Quality," IBM Research Report RC12514 (February 1987). 3 V. Cordonnier, "An Evaluation of Some Three-Color Tiling Patterns," IBM Research Report RC12897 (June 1988). 4 K. Knop, "Computer Simulation of Single-Chip Color Cameras," Journal of Imaging Technology 12, (5), 267-270 (October 1986). 5 G. S. Fawcett and G. F. Schrack, "Halftoning Techniques Using Error Correction," Proceedings of the SID 27, (4), 305-308 (1986). 6 R. W. Floyd and L. Steinberg, "An Adaptive Algorithm for Spatial Greyscale," Proceedings of the SID 17, 2 75-77 (1976). 7 P. H. Jackson, "The IAX Image Processing System: Reference Manual," IBM Research Report UKSC125 (May 1985). 8 G. Goertzel and G. R. Thompson, "Digital Halftoning on the IBM 4250 Printer," IBM Journal of Research and Development 31, (1), 2-15 (January 1987).

☐ 19. Document ID: NN8802191

L2: Entry 19 of 19 File: TDBD Feb 1, 1988

DOCUMENT-IDENTIFIER: NN8802191
TITLE: Pyramid Error Diffusion Algorithm for Halftoned Image

Disclosure Text (1):
- This article describes a new image halftoning method on a limited gray level or color display/printer and a new image halftoning algorithm called a "Pyramid Error

Diffusion Algorithm", which is a hybrid of the Error Diffusion scheme and the Ordered Dither scheme and overcomes disadvantages of both. 1.Pyramid Error Diffusion Algorithm Many image halftoning algorithms have been reported in the last decade. As to techniques for displays and printers of which dot sizes are consistent, we could divide these technologies into two categories: (1) Fixed thresholding approach, and (2) Dynamic thresholding approach. Although each has its own advantages and disadvantages, this approach can overcome the disadvantages of both. ***** SEE ORIGINAL DOCUMENT ***** Important factors to display a halftoned image are mainly high spatial resolution expression and smooth grayscale expression. It is known that the fixed thresholding approaches of which the ordered dither scheme is representative are advantages of the former, and the dynamic thresholding approaches of which the error diffusion scheme is typical are advantages to the latter they1Ù. For example, the error diffused image is generally a smooth expression, while we can see uncomfortable dot patterns called a "crystallizing effect" in the bright area in the image. It is also known that the ordered dithered image is not so smooth, although it has the best spatial resolution. In addition, the image halftoning algorithm should be able to control parameters to fit display devices of high quality. Considering above, we developed a new image halftoning algorithm called a "Pyramid Error Diffusion Algorithm", which is a hybrid of the Error Diffusion scheme and the Ordered Dither scheme and overcomes the disadvantages of both. In this approach, we use the pyramid data structure which is composed of original image level and mesh image level. In a mesh level image, we apply an error diffusion scheme, and in an original level image, we apply an ordered dither scheme. This algorithm is composed of two steps: (1) The "On" pixel number decision in a mesh, (Step 2) The "On" pixel position selection in a mesh. These procedures are described in the following: ***** SEE ORIGINAL DOCUMENT ***** 2.The "On" pixel number decision in a mesh First, the gray levels of the mesh image are calculated from the corresponding pixels in the original ones. Each mesh level pixel has a gray level sum of the original image pixels in the mesh (Fig. 1). To determine the "On" pixel number in a mesh, we apply an error diffusion scheme they2Ù in the mesh level image. The first step is to determine the "On" pixel number according to the gray level sum of the mesh. For example, when the final output image is binary, the number could be from 0 to 4 in a mesh. Next, the system calculates a quantizing error which is the difference between the original gray level sum and quantized gray level in a mesh. The error is diffused to surrounding meshes, as shown in Fig. 1. In this step, we provide a device-dependent threshold table to control grayscale changes between output devices, because of dot size and dot overlapping. The table contents are calculated by Gamma correction scheme. 3."On" pixel position selection in a mesh It is necessary to select "On" pixel positions in a mesh to output a natural grayscale image. We apply the ordered dither scheme to select the positions. At first, a thresholding is processed to an original image using a dither scheme. Two kinds of the dither patterns (Fig. 1.) are provided to avoid flashing on an interlace display. The dither pattern is changed mesh by mesh on the way to process the whole image. This will result in a binary or limited grayscale image in an original image level. The system counts "On" pixel number from this output image in a mesh. The "On" pixel number in a mesh also has been determined in the previous step. Now the system selects "On" pixels from these results as described in the following: If the "On" pixel numbers of the two steps are the same, the "On" pixels in a mesh are determined to the output described above. If the numbers are different, a quantizing error of each pixel is calculated as follows. Error = (Original Graylevel + Dither Level) - Quantized Level The "On" pixel number is arranged to the number determined in the previous step as the error sum is minimum. Fig. 2 shows the number arrangement procedure. To arrange the number, the error is sorted in a mesh. If the "On" number extracted in the dither scheme is larger than the previous step one, the system decreases the "On" pixel from the minimum error value pixel position. In the opposite case, it increases the "On" from the maximum error value pixel position. The output image is better than normal error diffusion and ordered dither schemes with respect to the following points: .no uncomfortable crystallizing effect, and .smoother expression than the ordered dither. 4.Hardware System To implement this halftoning algorithm, a hardware system structure has also been developed (Fig. 3). Since the approach consists of two steps and uses a pyramid data structure, three shift registers are provided as frame buffers (original image, mesh image, and output image). The image data is input as a raster-scanned data sequence and processed by pipeline scheme. The buffer 1 has two windows from which image data can be read. The window 1 is for generating mesh image in step 1, and the window 2 is

for the "On" pixel number arrangement in step 2. The error diffusion approach in step 1 is applied to the data in the window 3 on the buffer 2. This window has a special hardware to process the error diffusion algorithm. The pixel of attention on the buffer 2 is readable and used to determine the "On" pixel number of step 1. The step 2 procedures are processed in the lower part of the figure. To arrange the "On" pixel number in a mesh, the data in the window 2 on the buffer 1 are applied to the dither scheme described in the previous section. Then the "On" pixel number of step 2 is calculated. Comparing "On" pixel numbers between step 1 and step 2, the "On" pixel number arrangement logic performs the "On" pixel position decision. References 1 R. Floyd, and L. Steinberg, "An Adaptive Algorithm for Spatial Grey Scale," 1975 SID International Symposium Digest of Technical Papers, 4.3, 36-37 (April 1975). 2 J. F. Jarvis and C. N. Judice, "A Survey of Techniques for the Display of Continuous Tone Pictures on Bilevel Displays," Computer Graphics and Image Processing 5, 13-40 (1976).

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